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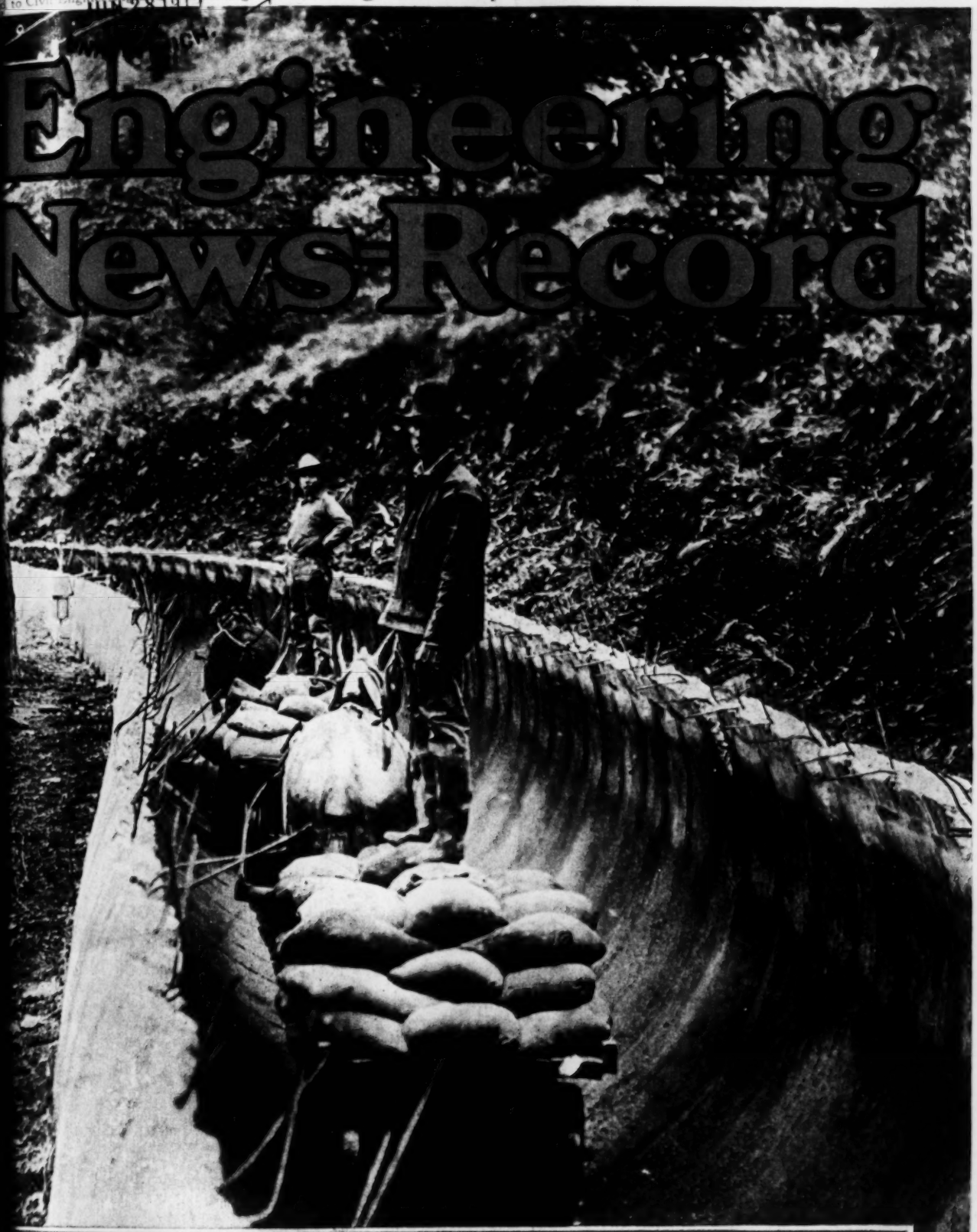

Storing and Handling High Explosives During the War

By G. C. MUNOZ

Sinking and Concreting Mine Shaft 936 Feet Deep

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Important and Neglected Features of Tire Maintenance

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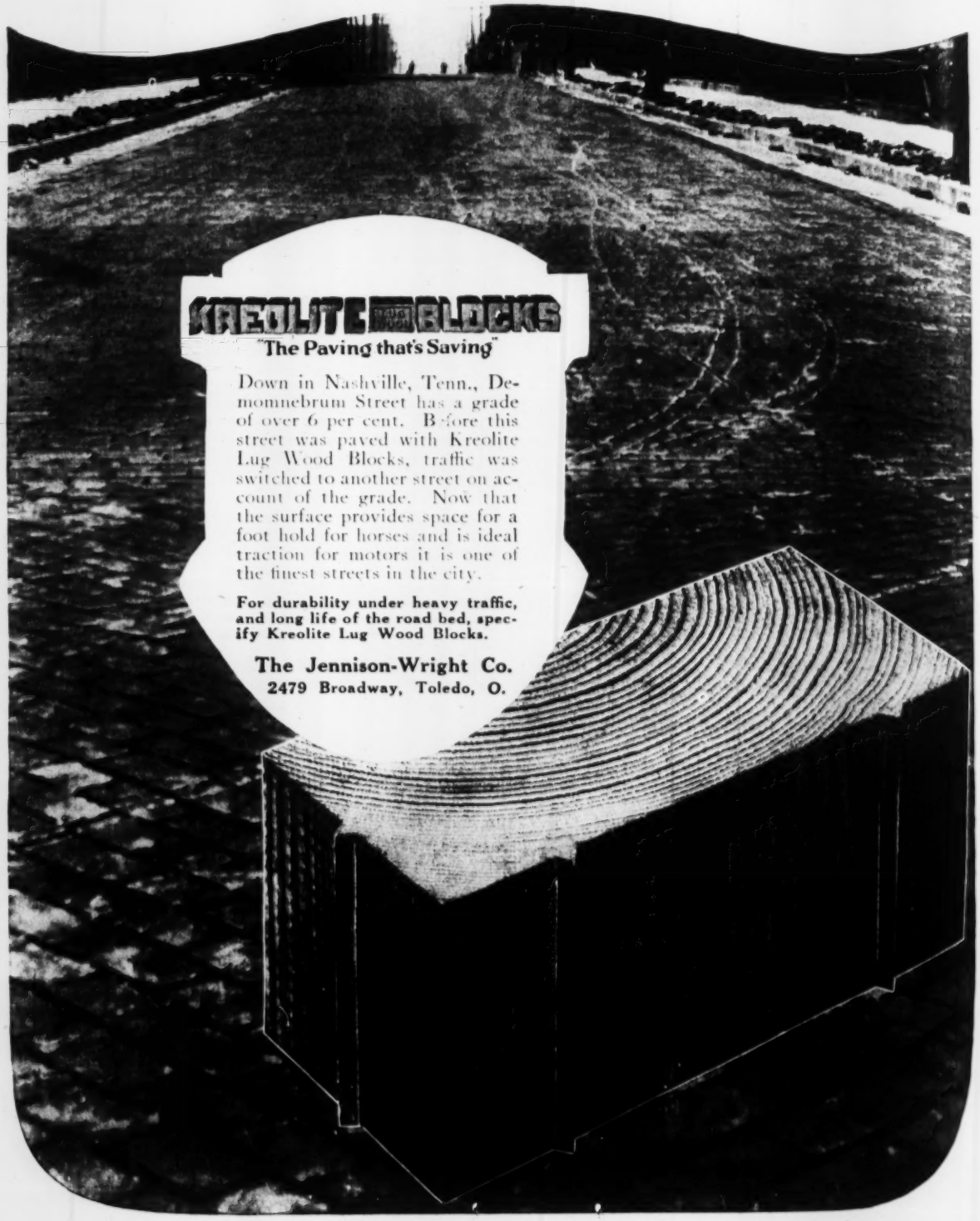
Cars Inside Yakima-Tieton Canal Used to Distribute Materials for Its Enlargement

KREOLITE LUG WOOD BLOCKS

"The Paving that's Saving"



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"The Paving that's Saving"

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ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. MEHREN, *Editor* — CHARLES WHITING BAKER, *Consulting Editor*

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Philosophy and Romance

SELDOM does one hear an address of such singular charm as that of Francis C. Shenehon, delivered before the annual convention of the American Society of Civil Engineers. His subject, "The Engineering Activities of the Twin Cities," invited a dry-as-dust treatment —a stringing together of facts and figures that would swamp the visitor but leave him impressed with the idea, however vague it might be, that he had come to a country of engineering wonders. Instead, the address has an irresistible pull, is inviting, not repelling, gives the basic reasons, geologic and economic, for the location of St. Paul and Minneapolis, and then paints the picture not only of what is but what may be in the future. The philosophy illuminates the romance and justifies the vision. We urge every engineer, no matter what his specialty or place, to read with care, and then reread, the address of Mr. Shenehon. It is not merely interesting and informative, but is an unusual model of something we sadly lack in our engineering writing—a technical theme handled with grace and charm, losing nothing of its technical value, but rather being enhanced by the treatment.

Precautionary Maintenance of Motor Trucks

MAINTENANCE is as essential to a motor truck as to the road upon which it travels. While this statement seems obvious, there is an abundance of ocular evidence that many contractors and other truck owners disregard it—in its preventive aspects, at least. This tendency is seen in the condition of tires which have been practically ruined by overloading, skidding, overspeeding, and misalignment of wheels. The reasons for this neglect are no doubt lack of understanding on the part of the owner of the cost of tires relative to other truck maintenance and lack of knowledge as to the principal causes of excessive tire wear. What may be the result of such abuse is set forth in an article by A. F. Masury on p. 1262. The facts presented are well known to tire and truck manufacturers and dealers, but it is doubtful whether the majority of truck operators realize that, normally, gasoline and tire costs are equal. Failure to grasp this fact is probably due to the insidiousness of tire wear. Gasoline waste is immediately apparent both in bills and decreased truck efficiency, but in tire abuse the damage occurs in a manner which is not noticed until the tire goes to pieces. Neglect of precautions against abuse leads to a tire cost which often outweighs the utmost possible extravagance in gasoline waste, an excess which is not realized unless accurate itemized cost data have been kept. In the absence of such data, particular attention should be given to preventing those conditions of truck adjustment and operation which are known to be destructive.

Another Joint Concrete Committee

THREE years ago the Joint Committee on Concrete and Reinforced Concrete completed its third and "final" report, and shortly thereafter its constituent committees were discharged by their respective societies. Since then the world has been too full of other activities to bother much about standard specifications. The final report was an admirable document, which, in spite of the rigidity and conservatism peculiar to the efforts of joint action, is recognized as having the authority it deserves. Nevertheless, the subject of concrete, like all other technical subjects, is moving, and fresh consideration of concrete specifications is now necessary. It is, therefore, pleasing to note that the American Society for Testing Materials, through its executive committee, has initiated action toward the formation of a new joint committee to prepare standard specifications for reinforced concrete, with the same constituent societies as were brought together in the older joint committee. This committee should be formed at once and should proceed immediately to work, for some time must elapse before a report can be expected from it. As was pointed out in these columns three years ago, the opportunity for some authoritative utterance on the manufacture of concrete is more important than one on the design. Much remains to be crystallized regarding concrete as a material. To this, it is hoped, the new committee will devote most of its attention.

"Movies" in Science

MOTION-PICTURE houses for some time have been showing pictures of what they call the "analysis of motion," in which well known actions, such as figure skating, sprinting and baseball pitching, are reproduced on the screen at one-eighth the actual speed of the performer. Every element of motion in these pictures stands out with snapshot clearness. Grace hitherto unsuspected is revealed, and the methods by which results are achieved are understood as never before. This latter phase has decidedly an engineering application in the development of motion study and its consequent readjustment of production methods. No false or unnecessary movement can escape detection, but at the same time the sense of motion, lacking in a series of snapshots, is always present. An analogy may be found in the system used by Nathan C. Johnson in studying the setting of concrete, as referred to on another page. While the popular "movie" film slows down normally fast processes, Mr. Johnson's automatic camera speeds up the normally slow, so that one can, for instance, observe in a few minutes the physical and chemical phenomena of many days. Motion pictures have already had a marked influence on social conditions; may they not have a bright future in science?

The Development Committee's Report

WITH the presentation to the board of direction of the progress report of the committee on development, there devolves on each member of the American Society of Civil Engineers a duty to study the report in detail and to communicate his views to the committee. Such is the wish and request of the board. The report has been prepared by a body representative of the society geographically and in varying points of view. It is a crystallization of ideas that have long been developing and that have assumed their present form after some months of study and four days of the hardest kind of work in Minneapolis.

Though the resolution accompanying the document states that the report contains "certain fundamentals which it is anticipated will form the basis of its ultimate report," it is clear from the discussion in Minneapolis that the committee is open-minded. It is seeking the views of the members of the society. It wants to know what of the content of the report they consider good, what they wish modified or rejected.

Space does not permit either detailed analysis or discussion. In general, it will be conceded, we believe, that the report stands on solid ground. Such radical innovations as the proposal to consolidate the four leading societies into one or to make the welfare work supreme are rejected. On the other hand, there is recognition that all engineering societies need to be drawn closer together, and that present conditions require more attention to welfare work than was necessary in the past. The provision for these steps is made without interjecting elements that would lessen the society's prestige.

In the four major divisions of the report the controlling ideas are plainly evident. In the category of technical activities, the spirit is that of development of a fuller service to the membership, a service that shall include in well rounded fullness the wide scope of what is now termed civil engineering. Question must be raised as to the source of the funds for the proposed enlarged work, but that will necessarily have the detailed consideration of the committee if the plans outlined are approved.

As to internal affairs, the ruling idea is that of organization along the lines of our Governmental system, so that the members in each community and each district may come to know one another better and by better acquaintance work more effectively for the advancement of the engineering profession. An important feature in this section of the report is the emphasis on the need for taking care of the younger members—not merely of the society but of the whole profession.

As to external relationships, the recommendations look to a federation for civic work of all elements of the profession, the method of organization being from the bottom up—through the locals and the state organizations to a national council.

In regard to public relations there are three dominant points: Publicity, that the function of the engineer may become better known; vigilance and action in matters of legislation affecting engineers; and the duty of the engineer as a citizen. As to each of these major lines of activity much will, we hope, be said in the near future.

It is evident that the committee has pitched high its ideal for the society. Appreciating the quality and the size of the membership, it proposes a program that a weaker body could not or would not dare attempt. As to the vision, generally, there will probably be little disagreement. As to detail and method there will be differences of opinion, and on these differences the committee desires light from the members.

In considering the report, there are two important facts to be remembered: (1) Whatever plans are evolved from the work of the committee will have the backing of nine thousand engineers of a class whose individual achievements are a warrant of effective action once they place themselves back of a definite program; (2) the ultimate report, strong as it will be with the backing of nine thousand civil engineers, will not stand alone. The other three national societies have similar committees. The inevitable conference report which, obviously, will not touch the internal affairs of the individual societies, will have mobilized for it the strength of forty thousand leaders of the profession.

The report, then, is destined, when developed into its final form, to have tremendous influence. Progress in the Mechanical Engineers' committee has been sufficient to show that the thinking in that society on external and civic relations is along parallel lines. The same vision is controlling that has actuated the Civil Engineers' committee—a vision of enlarged service to the profession and to the community. The other societies, if their participation in Engineering Council is a criterion, will have similar views. Forty thousand engineers united in effective organization, with a vigorous program such as they have the ability and vision to draft, can do more for the members of the profession than any other agency. Therefore, it behooves the members of the American Society of Civil Engineers to express their matured views on the report. The committee on development has reached the point where it must have their help and counsel. After the members have responded, the program for action can be formulated.

Good Roads on Long-Term Bonds

NEW York State has recently had a change in its highway administration, and with it has come a change in highway policy. The former administration, against the advice of its engineers, leaned, latterly at least, to the construction of a large mileage of cheaper type of highway. The object, if one may put it so, was political rather than statesmanlike—the desire to satisfy the clamors of the populace rather than to give them that which the state's own experience had demonstrated to be the most economical in the long run.

Furthermore, under the New York law the state assumes responsibility for maintenance and rebuilding, once it has taken over a road. It is to the interest of the local community, therefore, to get as much mileage as possible. If that mileage be constructed with a surfacing that wears out in four or five years, or less, it is no concern of the local community, except in so far as it contributes to the general state tax levy. It is a bad business procedure for the state, however, not merely because the maintenance cost of heavily traveled roads is high, but because the state highways are financed by fifty-year bonds, and with a continuance of this procedure issue upon issue would be piled up to pay for surfacings that had disappeared.

The figures in the New York case are very convincing. In the period from January, 1915, to December,

1918, the maintenance on 284 miles of brick road cost $210 per mile per year; on 208 miles of concrete roads, $138; on 2793 miles of bituminous macadam, penetration method, $490; on 2451 miles of water-bound macadam, $911, and on 173 miles of gravel macadam, $843. All of these figures are for the maintenance of surfacing without the reconstruction of more permanent or expensive types.

With such experience data available, we are not surprised at the reversal of policy in the highway department. Henceforth, ultimate economy is to be looked to and the mileage that the local communities do get will, in wearing ability, bear some decent proportion to the life of the bonds under which they are financed.

No one in these days will defend fifty-year highway bonds, but, that being the law, it is plain that the highest type construction only should be allowed on the heavily traveled roads.

City Transit Concentration

CITY growth has changed the aspect of many transit problems since the inauguration of the earliest rapid-transit systems. Improved transit facilities, constructed because of growing congestion, have in turn attracted more business to their neighborhoods, and have further increased the crowding of business and of traffic. Today transportation is the throttling point of city activities; housing, heating and lighting, telephone and other services have possibilities which our present demands do not approach, while the transportation systems are seriously overburdened.

New problems have come into being with the change of conditions. On the one hand, the congestion of traffic that has been created must be dealt with; better means must be devised for handling the very dense traffic with which existing transit routes have burdened themselves. On the other hand, concentration of traffic by a few transit routes must be counteracted and distribution of business and of traffic brought about. In connection with both directions of development, the coordination between street and transit routes needs to be improved, and the condition of mob-like crowding which exists at the entrances to important rapid-transit stations must be relieved. Some, perhaps all, of the new problems of transit congestion are worth consideration in connection with the discussion of continuous-train service which appears on another page.

If the continuous-train system will solve a sore and extreme problem, like that of 42nd St., it has much larger possibilities. Its distinguishing characteristics are its great traffic capacity, and its distributed station service. When we are confronted by serious overloading both of rapid-transit lines and of their street approaches, these qualities give the "moving sidewalk" a commanding claim for attention in transit planning.

Relatively few engineers have concerned themselves broadly with transit problems in the past; in the future these problems will concern many. City passenger movement—both surface and rapid-transit—is in the field of the municipal engineer, for it deals with one of the most essential services in the city's existence. Hitherto not all municipal engineers have been sufficiently free of the pressure of the moment's duties to face resolutely the problems which the future will bring. Mr. Seaman's article may prove helpful, therefore, by picturing conditions of serious character which, though now restricted to only two or three cities, are likely to become much more general.

Of greatest value, perhaps, is the emphasis which consideration of continuous trains lays upon what may be called the crosstown traffic problem. Reference to the conditions existing in the southerly one-third of Manhattan Island will bring this problem most clearly before the mind, although it exists in every large city. It is the problem of delivering traffic to an area rather than to points along a line—in other words, of distributing from the trunk lines of transit; and in Manhattan this distribution is crosstown. The one- to two-mile width of the island is adapted for highest-grade business use over its entire width, yet in the past only the central axis has been so developed, while the outskirts, because distant from the central axis, were left to second- and third-class service. In earlier years, moreover, concentration of all major business along a single line was most in harmony with the needs of the business. But, many decades ago, the facilities of a single street were out-grown, and today the great need is for means of spreading the traffic from river to river.

Counteracting the natural tendency toward lateral spread, however, there has been in New York the obstacle of the growing difficulty of crosstown transit. In recent years this difficulty has become serious indeed. The problem has had some study by the rapid-transit construction authorities of the city, but action has ever been blocked by the greater pressure for improved longitudinal transit. It may be hoped that now, with the principal rapid-transit lines nearing completion, the formidable crosstown problem may be taken in hand again. And it may also be hoped that the lessons sure to flow from such study will be noted by the engineers of other communities with respect to their bearing upon local transit needs and plans.

In view of the large possibilities of the continuous-train system, it is remarkable that no trial installation has been made so far. Important objections to the system lie on the surface. There are undoubtedly great mechanical difficulties in the problem. Equally serious doubts may be entertained concerning the ability of a miscellaneous public to use a moving device. But both classes of doubt may be regarded optimistically. As concerns the adaptability of the public, the doubts indeed have largely been deprived of their force by the success attained with moving stairways; their heavy patronage, even in the stores where they are used by women and children almost exclusively, and are often without attendance, overthrows the fear that moving transit devices are dangerous. With respect to mechanical difficulties, the case may be considered in the light of other unpromising railway problems that have been worked out to complete, practical success. In short, the striking correlation between certain vital transit needs, on the one hand, and the improved facilities afforded by the continuous train, on the other, is bound to force the system into notice, and, while difficulties of serious character may be expected in applying it, they do not appear insuperable.

The 42nd St. problem is only one of a class of crosstown problems in New York. The city is a ribbon of parallel threads which lack the bonding strength of cross-connection. Complete control of the crosstown problem, if it can be attained, will create a new basis for the city's development.

Storing and Handling High Explosives During the War

Methods Developed by Ordnance Department in Taking Care of Vast Quantities of Ammunition Were Based on Safety Regulations and Modern Material-Handling Devices

By G. C. Munoz

Major, United States Army, Chief of Construction Section, Supply Division, Ordnance Department, Washington, D. C.

HIGH explosives of the kind used in ammunition are rare commodities in peace times, but even their occasional use would seem to make it worth while to record for future reference the methods of handling and storage developed by the United States Army during the war. To assure the necessary steady flow of this ammunition to the American Expeditionary Forces, embarkation depots capable of handling a 30-day supply had to be built at seaboard points, remote from large communities and yet within the lighterage limits of the major ports from which the material was shipped. The principal problem to be solved in planning these depots was the adoption of standard types of magazines for the safe storage of ammunition, smokeless powder and explosives; the planning of terminal track and wharf facilities for the rapid handling of large amounts of ammunition; and the protection of the military stores from fires or from enemy attack.

Seven of these depots were established along the Atlantic seaboard; they were located as noted in the accompanying table. In addition, storage facilities were provided at the principal shell-loading and bag-loading plants, and since the signing of the armistice special depots for the storage of high explosives have been established in sparsely settled regions in the interior of the country. The tidewater depots were all designed in accordance with certain fixed standards which are given below, although, of course, in each case there were many variations in local conditions which required special detailing. The general layout of an ideal depot is shown in the accompanying drawing.

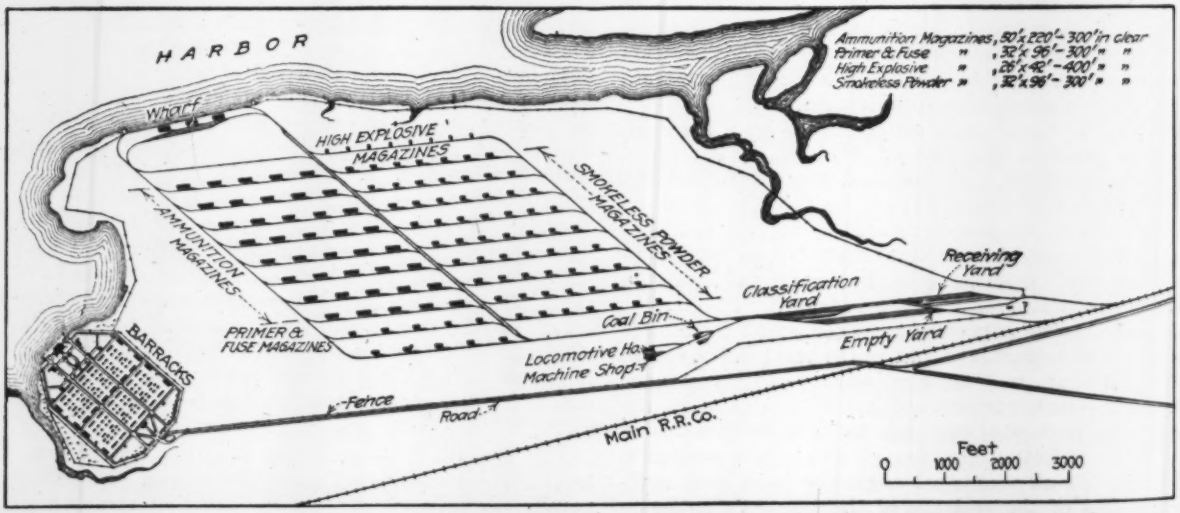
TABLE SHOWING LOCATION AND COST OF ARMY AMMUNITION SEABOARD DEPOTS.

Depot	Harbor	Cost
Raritan Arsenal, New Jersey	New York	$14,883,000
Sandy Hook Ordnance Depot, New Jersey	New York	972,000
Delaware Ordnance Depot, New Jersey	Philadelphia	6,350,000
Curtis Bay Ordnance Depot, Maryland	Baltimore	8,253,000
Turner Ordnance Depot, Maryland	Baltimore	93,000
Pig Point Ordnance Depot, Virginia	Hampton Roads	3,340,000
Charleston Ordnance Depot, South Carolina	Charleston	5,516,000
Total Cost		$39,407,000

As a result of the study of various explosions of ammunition in storage it was concluded that, as in the event of an explosion in any ammunition magazine the shells might be hurled for a distance of one-half mile, it would therefore be necessary to space the magazines that distance apart, to preclude the danger of a bursting shell being hurled from one magazine into the next one and there causing a second explosion. This was obviously impossible, as it would have entailed the construction of tremendous amounts of railroad track and would have required the acquisition of much larger areas of land than could possibly be obtained in the neighborhood of our principal seaports. Experience indicated that a spacing of 50 ft. between magazines would be sufficient to preclude the danger of sympathetic detonation between magazines. It was necessary, therefore, to choose between the above two limits, and a spacing of 300 ft. in the clear between magazines was finally decided upon. The standard layout adopted was to stagger alternate rows of magazines, as this resulted in a slight economy in land.

In planning storage for high explosives in bulk, it was decided that a maximum amount of 250,000 lb. of high explosives per building would not be exceeded. The size adopted as a standard was 24 x 40 ft. by 9 ft. high.

The proper spacing of high-explosives magazines one from the other, and the distances that should be maintained between magazines and inhabited dwellings, railroads, highways, etc., were carefully studied. It was decided to comply with the requirements of the American table of distances regarding inhabited dwellings, public highways and railways outside of the ordnance depots. This table was a result of the studies of a

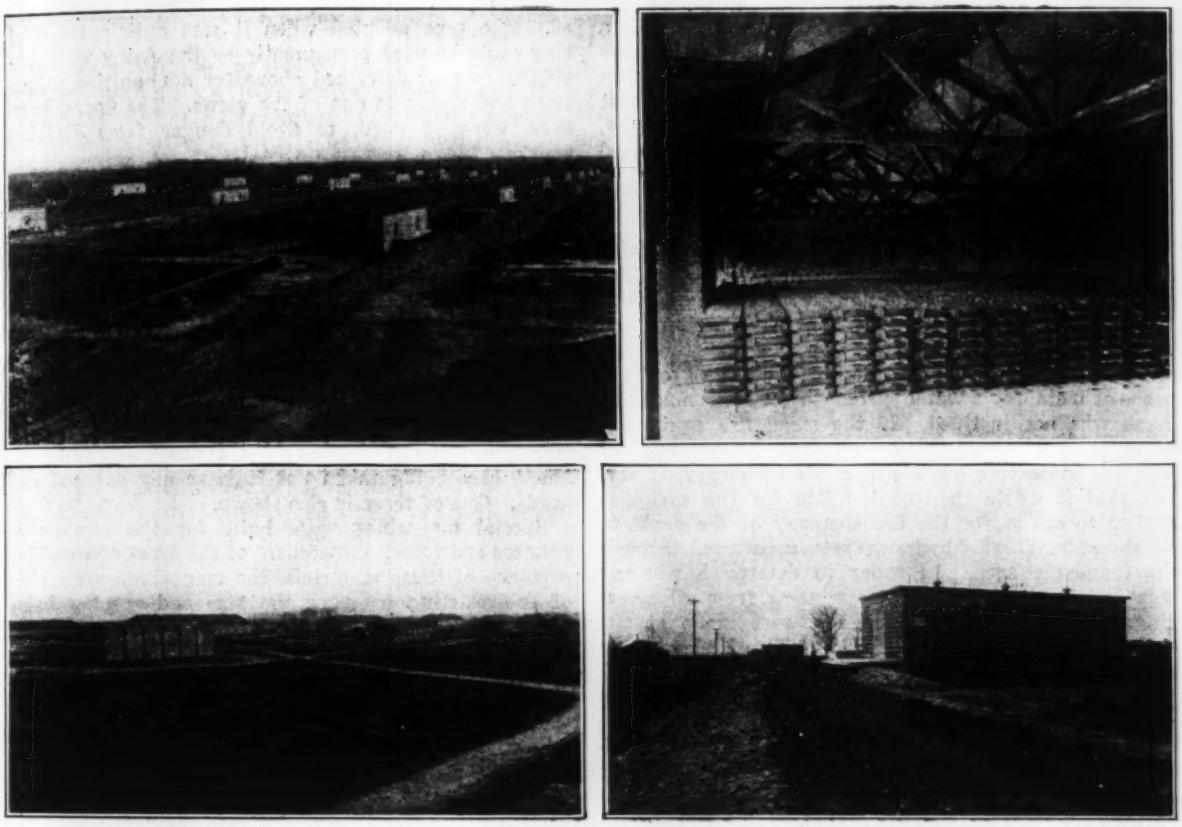


GENERAL LAYOUT OF A TYPICAL ORDNANCE DEPOT, USED AS AN OVERSEAS AMMUNITION-SHIPMENT POINT DURING THE WAR

special committee appointed by an association of manufacturers of powder and high explosives established in 1910 and revised in 1914.

A model law for regulating the storage of explosives recommended to various states by the Institution of Makers of Explosives contained a clause regulating the distance between magazines as follows: For 25,000 lb., the spacing between barricaded magazines should be 100 ft. and for each additional 1000 lb. of explosives there should be added a distance of 1½ ft., and for magazines without barricades the above spacings should be doubled. According to this rule the barricaded distance between magazines containing 250,000 lb. would be 400 ft. and after consultations with various experts on explosives, it was decided that on account of the relative insensibility of the principal military explosives, T.N.T. and picric acid, as compared with the demolition explosives for which the above rules were made, it was proper under war conditions to store the military explosives in unbarricaded magazines at the barricaded distances described above. This was finally adopted as a standard for the supply division, and all high-explosives magazines of 250,000-lb. capacity were spaced 400 ft. apart in the clear, unbarricaded.

It was decided that smokeless powder should be handled through the ordnance depots in bulk for the reloading of 75s and 4.7s overseas, and loaded in bags for propelling charges for the shells of larger calibers, the bags being packed in fiber or metal containers, those of the latter type being more bulky and more dangerous because each bag contained a core of black powder to assist in the rapid combustion of the charge. A practical test made with several boxes of smokeless powder demonstrated that this material in bulk burns very rapidly but does not explode. It was, therefore, decided that the maximum amount of smokeless powder in bulk to be stored in one building should be 500,000 lb. Allowing for proper ventilation around the walls and for the necessary aisle space, this amount of smokeless powder required a building 32 x 96 ft. by 10 ft. high, which was adopted as the standard-size smokeless-powder magazine.



TYPICAL POWDER AND AMMUNITION MAGAZINES USED BY ARMY DURING WAR IN PORT DEPOTS

Upper left, smokeless powder magazines in group. Upper right, interior of ammunition magazine. Lower left, primer and fuse magazines. Lower right, high explosives magazine

Studies of fires in smokeless-powder factories showed that the flame from a conflagration of a large amount of smokeless powder would reach great distances. It was decided to space the smokeless-powder magazines 300 ft. apart in the clear, as experience available indicated that this would be sufficient to prevent a conflagration in one building from spreading to the adjoining buildings. The spacing adopted is clearly shown in the view of this type.

After the signing of the armistice a revision was made of all high-explosives magazines at the depots established on the Atlantic seaboard, and it was decided that, as a peace-time basis for storage of explosives, the amount of high explosives per magazine should be reduced so that the distance between them would be in strict compliance with the rule described above for the spacing of high-explosives magazines. For the storage of large amounts of surplus high explosives that were on

hand at manufacturing plants, loading plants, etc., new depots were established in sparsely settled areas in the interior of this country. The amount of explosives in them was limited to 250,000 lb. per magazine, and magazines were spaced 800 ft. apart, which is the unbarricaded distance in accordance with the rule referred to above.

In planning the fire protection for the ammunition depots, consultations were held with the manufacturers of explosives, with other experts on the subject, and with the National Board of Fire Underwriters. As a result of this a standard policy of fire protection was adopted and followed at all of these depots. The problem of fire protection was devided into two classes, the first being the protection of the ammunition-storage areas, and the second being the protection of barracks, general storage warehouses, wharves and railroad yards.

Sprinklers Not Warranted

The question of providing the magazine area with hydrants and equipping the magazines with sprinkler systems was discussed informally with the representative of the National Board of Fire Underwriters and with manufacturers of explosives. After thorough study of the matter, it was decided that the great expense of installing a water system through the magazine areas was not justified. If the small fire equipment which it was planned to place at all magazines was not effective in putting out a fire in its incipiency, it was felt that it would then be too late for the sprinkler system to act or for the fire company of the depot to obtain water from a hydrant system scattered through the magazine area. In order to determine whether this decision to omit sprinkler systems from all magazines was justified, arrangements were made at the suggestion of the National Board of Fire Underwriters and through the courtesy of E. I. du Pont de Nemours & Co. to make tests at Carney's Point to determine the value of a sprinkler equipment in fires in the storage of smokeless powder, T.N.T. and picric acid under different conditions. It was the consensus of opinion after these tests were made and studied that the cost of a sprinkler system was not warranted.

It was endeavored to prevent the occurrence of fires in the magazine area by precautions in the construction of the magazines, in guarding, in clearing the magazine area of all fire hazards, and in equipping the locomotives with fire equipment, spark arresters, and specially inclosed ashpans, in order to reduce as far as possible the danger of fire from these sources.

The magazines were protected from fire by a liberal supply of small fire equipment, both inside and outside. The type of small equipment generally used was 40-gal. bucket tanks and 5-gal. hand-pump extinguishers, both being filled with nonfreezing solutions. The fire protection for the barracks was the standard type developed by the Army and used at all cantonments. Other important features of the fire protection of the depots were the organization of fire brigades, the establishment of a fire-engine house with facilities for housing the fire marshal and his crew, the installation of electric fire-alarm systems, a liberal installation of telephones, and the construction of numerous small guard houses for housing the detachments assigned to guard duty.

In the design of the ammunition magazines it was attempted to reduce to a minimum the danger from missiles in the event of an explosion; to make the magazines as nearly fireproof as possible; and to make the buildings dry and well adapted to the mechanical handling methods that had been decided on. The standard adopted was a building 50 x 218 ft., with brick pilasters, tile walls, concrete floors and roof of gypsum slabs resting on wood roof trusses and wood purlins. The walls should eventually be plastered on the outside, but this was omitted for the sake of speed and economy. This construction is shown in the views.

Three types of high-explosives magazines were adopted. The type adopted when it was anticipated that they could be used permanently by the Army was very similar to that described above for ammunition magazines and shown in one of the views. The floors, however, were of wood, to avoid danger from striking sparks.

For temporary use, a wood-frame magazine with corrugated asbestos sheathing and gypsum slab roof was used; and for storing dynamite, which material could be detonated by a rifle bullet, bullet-proof magazines were constructed. These latter were similar to those of the permanent type except that the tile was filled with sand and the fire doors were bullet-proofed with steel. A test made with an Army rifle, by firing three bullets at the same spot of a sand-filled tile, resulted in penetrating only the outside shell of the tile.

Smokeless-powder magazines were built of wood frame, corrugated asbestos sides, gypsum roof and wood floors, care being taken not to have any exposed nail heads. One of these is also shown.

Special magazines were built for the storage of primers and fuses. On account of the great cost and importance of these materials, the magazines were made of fire-resisting exterior, the size and spacing being the same as for the smokeless-powder magazines (32 x 96 ft., and spaced 300 ft. apart). The walls of these magazines were of tile, the roof was of gypsum, and the floor of blind-nailed wood plank.

Transportation Methods Important

It was planned to transport ammunition from the magazines to the wharves on flat-cars covered with tarpaulins and to transport explosives in box cars. For the rapid transfer of this material to lighters a front track was built as close to the pierhead line as possible, and light shells and explosives were skidded on hardwood skids direct from the cars to the lighters. For the transfer of heavy shells 15-ton locomotive cranes with 50-ft. booms were provided. These cranes operated on the front track, the flat-cars with shells being spotted on a second track spaced 18 ft. c. to c. from the front track. This spacing gave ample width for the operation of the crane. The standard width of wharf adopted was 46 ft., which left sufficient width in the rear of the second track to permit a fire engine or automobile to pass when the tracks were blocked with railroad equipment. The top of the rail of the front tracks was flush with the floor level, in order to permit of trucking across the tracks when necessary.

The wharves were designed for a live load of 500 lb. per square foot, and the tracks for either a Cooper E-40 locomotive or a 15-ton crane with loaded boom at point of overturning, the boom being so placed as to produce the maximum loads. All bracing was kept at least 3 ft. above mean low water, in order to avoid the delay usually encountered when placing bracing near low-tide level.

Dock sheds of fire-resisting construction, 60 x 216 ft., and spaced approximately 300 ft. apart in the clear, were built directly in the rear of the wharf, and were used as transfer sheds are used on commercial wharves. The floors of these buildings were of reinforced concrete supported on wooden piles and were designed to carry a live load of 600 lb. per square foot. Depressed tracks were built in the rear of the dock sheds to facilitate the rapid unloading of cars into these buildings, and behind these loading tracks small yards were provided to assist in the quick shifting of cars at the wharves.

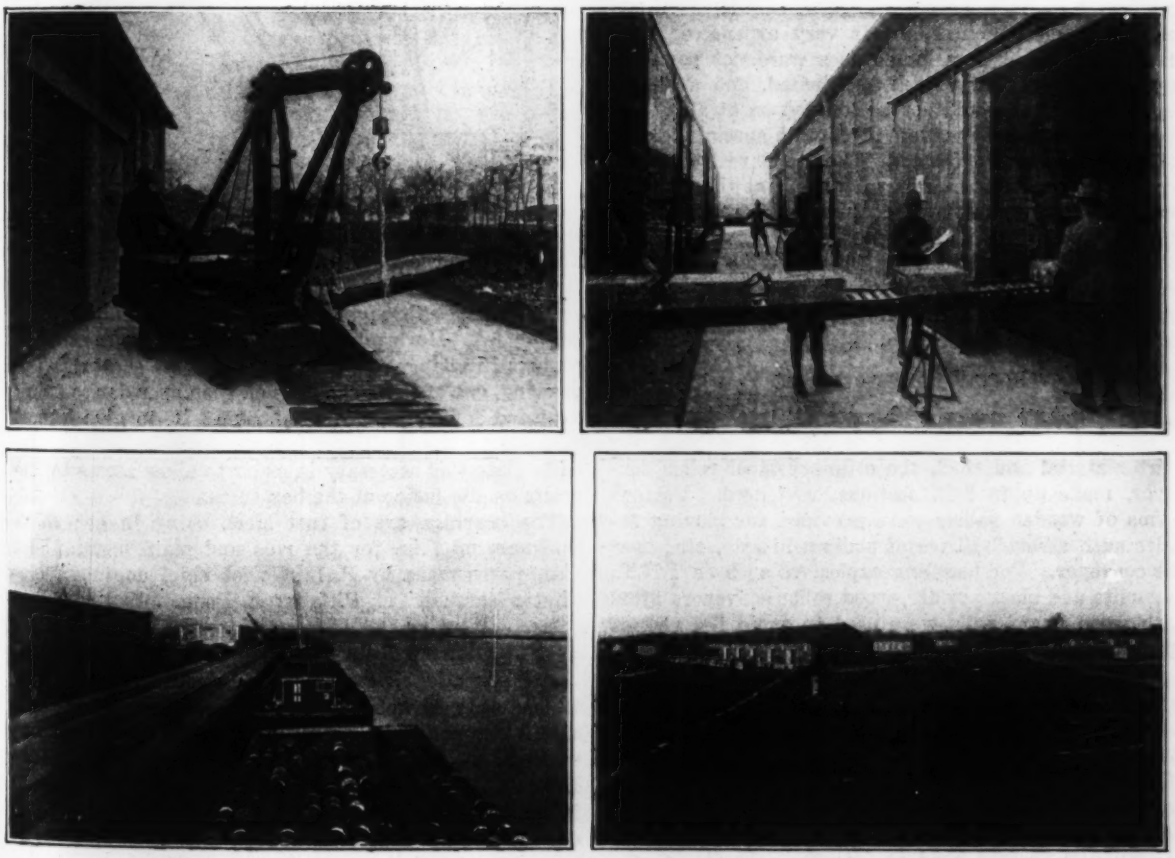
Fire walls were built under all of the ordnance wharves, concrete walls being spaced approximately 510 ft. apart. with intervening timber fire walls constructed of two layers of 2-in. plank, one layer being placed vertically and the other horizontally, and spaced approximately 170 ft. apart.

The plan for the pier at Pig Point, Norfolk, Va., differed slightly from the above plan; it was built 4000 ft. from the shore, and it was not anticipated that very heavy shipments would be made from this point. The pier was therefore built 105 ft. wide with a dock shed 260 x 40 ft. with surface tracks on one side and depressed tracks on the other, both sides of the pier being provided with fender piles so that lighters could be loaded on both sides when desired. As a certain amount of vibration was inevitable on this pier, the dock shed was built of wood-frame construction covered with corrugated asbestos.

A railroad system was constructed at each depot to make access easy to any point and to provide receiving and classification yards for incoming and outgoing cars. The main running tracks and yards were placed at a safe distance from the magazines. Curvature of track was limited wherever possible to 13°, to preclude any trouble from derailments. The 80-lb. A.S.C.E. rail was selected as a standard for ordnance depots, but, on account of the difficulty of obtaining these rails quickly, a good deal of 67½-lb. rail, which had been manufactured for the Imperial Russian Government but had not been shipped, was used, and proved very satisfactory.

All ammunition depots were surrounded by high fences built of 2-in. chain-mesh woven wire fence of No. 9 galvanized wire surmounted by three strands of barbed wire on an inclined arm, the total height of the fence being 8 ft. To assist in the guarding of the depots a series of flood lights, spaced approximately 500 ft. apart, were installed, mounted above the fence and throwing powerful beams of light parallel to the fence, thus thoroughly lighting a zone approximately 100 ft. wide outside the depots. That the guards inside of the fence might remain in darkness so that they could not be seen from the outside, vertical veins were fastened to the projectors; these reflected all rays directed toward the inside of the inclosure. The projectors were generally spaced 500 ft. apart.

Very careful consideration was given to the use of electrically driven machinery for handling ammunition and explosives in the magazines, but it was decided that any economies that might be gained by the use of this



MECHANICAL METHODS USED IN HANDLING AMMUNITION IN ARMY'S STORAGE DEPOTS

Upper left, electric crane handling heavy shell. Upper right, shrapnel on roller conveyor. Lower left, handling ammunition to barges. Lower right, roller conveyors between magazines

machinery were more than offset by the added risk entailed in running power lines into the magazines. It was, therefore, decided that for powder and high explosives no electrical machinery would be used, and for shells the use of power-driven machinery would be confined strictly to storage-battery equipment, and that the charging of all storage batteries would be carried on in a building outside of the magazine area. Battery-charging stations at safe distances from the magazines were therefore established at all of the principal depots.

On account of the short winter days, and as it was desired to be prepared to handle shipments day and night when necessary, it was essential to provide a means of lighting the magazines. This was accomplished by the use of storage-battery portable lamps, developed for this purpose. These lights were charged at the battery-charging station and could be carried to any magazine where night operations were under way.

Preliminary estimates showed that the trackage at the various depots would average from 10 miles at the small depots to 45 miles at the larger ones, and that the number of carloads passing through each depot would average from 15 to 243 per day. With these facts in mind, studies were made of various types of motive power, including electric locomotives, compressed air, fireless locomotives and oil burners; but there were certain objections to the use of all of these types under war conditions, and it was therefore decided to use for all heavy switching 62½-ton coal-burning steam locomotives, and for light work 40-ton locomotives. The principal reasons for this decision were that electrical equipment was scarce and the large trackage at the depots would have made electric installations very expensive; compressed-air and fireless locomotives were not powerful enough for the heavy work anticipated, and a steady supply of fuel oil could not be counted on at all of the depots. All locomotives were fitted with special inclosed ashpans and spark arresters. The standard locomotive crane adopted for handling heavy shells at the wharves was a 15-ton, eight-wheel, coal-burning crane with a 50-ft. boom.

All of the rolling stock for the operation of the depots was ordered at the commencement of the projects and was used to great advantage by the construction forces.

Roller Conveyors Used

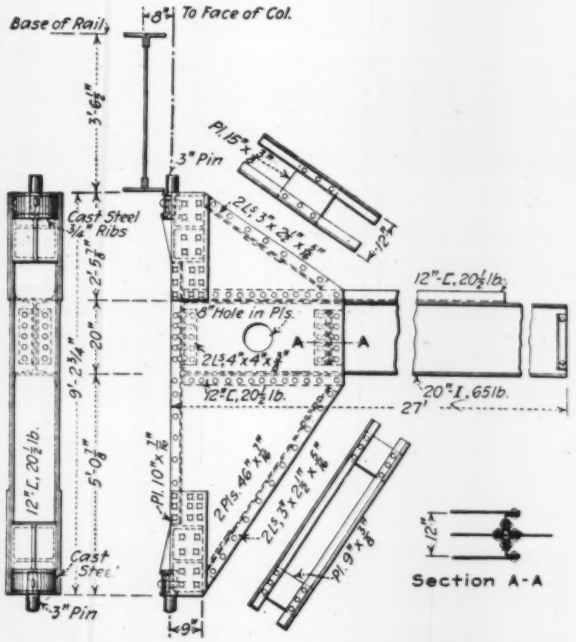
For handling material from cars into magazines, roller conveyors were utilized as far as possible. For inert material and shell, the ordinary steel roller conveyor, made up in 8-ft. sections, was used. Various forms of wooden pallets were provided for moving articles such as shells, bags of sodium nitrate, etc., over the conveyor. For handling explosives such as T.N.T., dynamite and black powder, wood roller conveyors fitted with wood guard rails were used to avoid the risk of sparks.

For handling shell above 12 in. in diameter a special type of storage-battery transfer crane truck, fitted with a short hinged boom and a hoist motor, was provided. As the platforms of the magazines used for the storage of heavy shells were built at car-floor level, this truck could be driven into the car, take a shell either by the nose ring or by means of a rope sling, back out of the car and proceed head on into the magazine to the point of storage. A view is given of one of these cranes in operation.

Jib Crane Designed for Maximum Clearance

TO REDUCE the overhead height of jib cranes recently installed in the Carnegie warehouse of the McClintic-Marshall Steel Supply Co. and thereby give maximum underclearance and lifting height, a special design was developed, using, instead of tension stays to take the cantilever moment, what was virtually a vertical girder. The details of this design are reproduced herewith.

The vertical girder was built up of two main plates with a 12-in. channel on the side near the column, and



SPECIAL DETAILS OF CANTILEVER JIB CRANE

with angle stiffeners and tie plates supporting the edges. The main cantilever beam was framed into the vertical channel just mentioned, and was also connected by four vertical angles through the main plate, as indicated by section AA. Horizontal 12-in. channels were selected to connect the flanges to the main plate, as shown in the drawing, one of these channels on the upper flange being extended for a distance of about 18 ft. to give lateral stiffness to the cantilever beam. An 8-in. hole in the main plate was necessary in order to allow access to the rivets on the inside of the box section.

The bearings are of cast steel, using in general a thickness of ¾ in. for the ribs and main metal. The design was made by P. L. Wolfel, chief engineer, McClintic-Marshall Co., Pittsburgh, Penn.

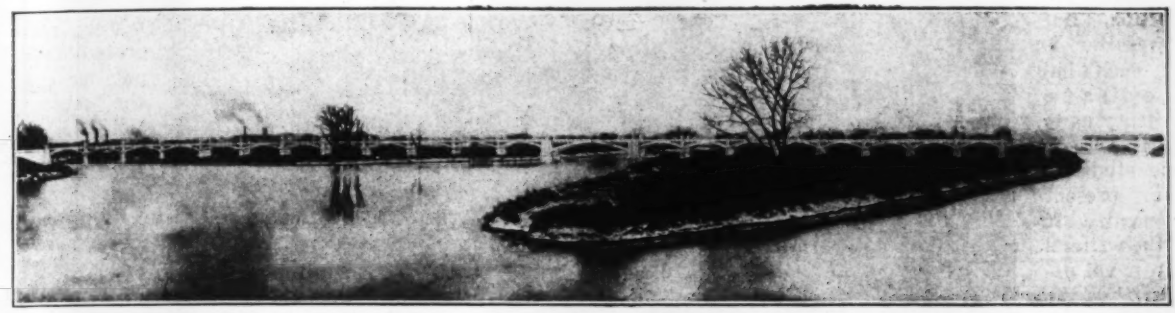
Publicity To Help Minnesota Water Projects

An educational campaign to assist municipalities which need new water-supplies or improvements in their existing supplies is a new activity being carried out under H. A. Whitaker, director of the Minnesota State Board of Health. The program includes a thorough investigation and report, also conferences with local officials and organizations, and lectures at public gatherings, in order that the people may have an opportunity to realize the importance of the problem before the time arrives for voting the necessary funds.

Long Concrete Bridge Contract To Be Let in Four Parts

Structure Nearly Mile Long Across Mohawk River and Barge Canal at Schenectady About To Be Built

JUST before the United States entered the war the State Engineer of New York had prepared plans for a long, reinforced-concrete bridge across the New York State Barge Canal and the Mohawk River between Schenectady and Scotia, N. Y. The work was held up during the war, but appropriation has now been approved by the legislature and preliminary work incident to the award of contracts will be begun immediately.



GREAT WESTERN GATEWAY, A CONCRETE BRIDGE NEARLY A MILE LONG, TO BE BUILT AT SCHENECTADY, N. Y.

In addition to the size of the structure, it is interesting on account of the novel division of labor proposed for the construction. Under a plan now in preparation, the first contract to be awarded will involve the construction of the approaches and abutments at either end of the bridge. The second contract will involve the excavation, the driving of foundation piles, the placing of concrete in the foundation of all the piers and abutments exclusive of the end abutments. This contract can be awarded at practically the same time as the first one, inasmuch as the two contractors can operate without any material interference. As this second contract will be composed almost exclusively of work in which contractors experienced in the building of foundations and the driving of piles would be interested, it is thought that keen competition will result. The third contract consists of placing concrete above the foundation lines, including arches and balustrades in the main portion of the structure, and the fourth in the pavement of the bridge and approaches. This fourth will be the last part of the work to be placed under contract. Under this scheme the first and second contracts would be practically completed through the 1919 season, and in 1920 the third contract would be awarded; the work would be completed toward the end of 1921.

The bridge is to be called the Great Western Gateway or Gateway Bridge. It has a total length of 4436 ft. comprising 23 spans varying from 106 ft. to 120 ft., and one 212-ft. span over the Barge Canal channel. The river at the site is divided into three channels by Van Slyck Island and Hog Island. Between Van Slyck Island and the Schenectady shore is the channel which leads up to the Schenectady Barge Canal terminal. Between the islands is the Barge Canal channel, and between Hog Island and Scotia is the river.

Starting at Washington Ave., Schenectady, as the continuation of State St., the main artery of east and west traffic through the city, the first 300 ft. of the structure to the Schenectady abutment will be in the form of a parkway 100 ft. wide between retaining walls. In the center of this will be a grassed reservation 20 ft. wide for street-railway tracks, and flanking this will be reservation roadways, 20 ft. wide, for vehicular traffic. Flanking the roadways will be grassed areas 10 ft. wide and then outside concrete sidewalks 10 ft. wide. From the Schenectady abutment to the Scotia abutment the roadway will be 40 ft. between curves, with double tracks for electric cars in the center, and two 6-ft. sidewalks. Four arch spans 106 ft. each, cross the terminal channel to the triangular pier on Van Slyck Island, where the bridge turns at an angle of 54°. The crossing of Van Slyck Island is in three arch spans 110 ft. each, one arch span 117 ft., all square-ended, and four arch spans 120 ft. each on a skew of 18°. Then comes the 212-ft. span across the Barge Canal, which is on a skew, then six 120-ft. skew spans, an anchor pier on the far side of Hog Island, and five more skew spans of 120 ft. each. The structure between abutments is divided into five sections by two anchor piers and the massive piers of the channel span.

All arches will be open spandrel, rib type. The 212-ft. span will be carried on two ribs 12 ft. wide, 24 ft. apart. All other spans will be carried on three ribs, the outer ribs 6 ft. wide and the center rib 12 ft. wide, with a clear distance between ribs of 12 ft. On the Scotia end, for a distance of 940 ft., the approach will consist of an earth embankment.

The new structure will replace the old steel toll bridge which crosses the river about 1200 ft. to the east. It will be paid for jointly by the State of New York, the City of Schenectady, the County of Schenectady and the Village of Scotia. The contract plans were prepared by Frank M. Williams, state engineer, from the original design by B. H. Davis, consulting engineer.

Good Results From Filter Galleries

Bacterial count of the water obtained in 1918 from the underground galleries of the Des Moines, Iowa, Water Works Co., which are flooded at times of low river stages and high consumption, indicated a 94.5% reduction from the average of 19,047 bacteria per cubic centimeter in the adjacent Raccoon River. Treatment with chlorine gas reduces this count to 48, according to a paper read at the recent meeting of the Iowa Section of the American Water Works Association by A. T. Luce, engineer and superintendent. The rate of infiltration from a series of ditches and pools extending along the land side of the galleries is estimated at 1,000,000 gal. daily per acre flooded.

Continuous Trains for Forty-Second Street Transit

Problems of Dense Traffic—Moving Platforms or Continuous Train Recommended for New York Ten Years Ago—Shown to Have Advantages in Speed up to Four Miles, and Remarkable Capacity

By Henry B. Seaman

Consulting Engineer, New York City; Former Chief Engineer of the Public Service Commission for the First District, New York

A RAPID-TRANSIT problem of peculiar importance is contained in the case of the 42nd St. shuttle-train service in the new subway system of New York City. The problem is that of short-distance transfer of a very dense traffic, and is by no means confined to New York City or to the 42nd St. connection. But the latter is of such immediate urgency as to require serious study at the present moment. It is the writer's conviction that the moving platform, or the continuous-train system, offers the only solution of this problem. Moreover, the same system is able to meet requirements of exceedingly dense rapid-transit traffic in other cases, for long as well as short distances. In the present period of active rapid-transit development, the subject merits general attention.

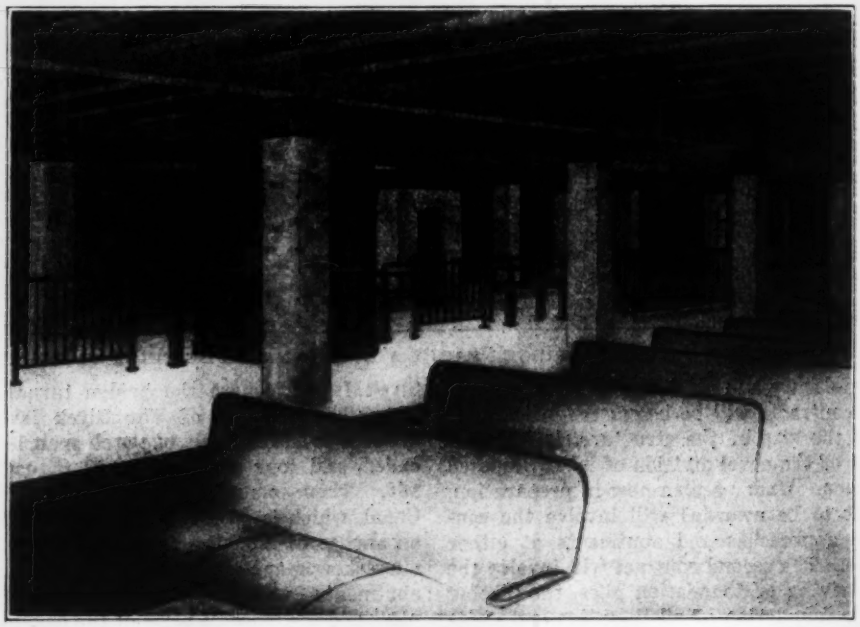


FIG. 1. HOW A MOVING PLATFORM SUBWAY INSTALLATION WOULD APPEAR, WHEN VIEWED FROM THE CENTER LINE OF COLUMNS (SLOW SPEED APPROACH PLATFORMS BEYOND THE SEAT PLATFORMS)

Ten years ago, when chief engineer to the Public Service Commission of New York City, the writer reported to the commission that moving platforms offered distinct advantages over separate trains with respect to speed as well as to capacity, recommended that an installation be made forwith. The general facts set forth in that report are as fully applicable today as then, and reference to them will support the statement that other rapid-transit routes than the 42nd St. shuttle connection may advantageously be equipped with continuous trains.

When the original subway, running north and south in Manhattan, was built, it was laid out on an indirect route through 42nd St., in order to reach the most populous localities and thus insure the immediate financial success of the project. But it was evidently intend eventually to complete the east- and west-side routes as now constructed. It would, therefore, seem that the connecting link across 42nd St. should have been considered and designed at the same time, in order to function with this general subway development. That this was not done can only be explained by the extraordinary pressure to rush the general improvement.

When, upon the opening of the new subways, it was found that no consideration had been given to this important matter, and it became necessary to close down the crosstown service in 42nd St. temporarily in order to avoid the resulting confusion, the citizens were naturally surprised and expressed disappointment. At the suggestion of the chairman of the commission, colored guide lines were then introduced. This was expected to reduce confusion, and the shuttle service was reëstablished. Other than this, however, there have apparently been no serious attempts to provide permanent relief of the congestion and inconvenience at this point.

A suggestion has recently been made by a former member of the commission that the shuttle service be operated from 14th St., running trains on the local tracks of the main line to 42nd St. and thence across to Seventh Ave. As a considerable portion of the crosstown traffic comes from the Steinway tunnel on the east and an ever-increasing number from the Lexington Ave. extension on the north, such operation would offer, at best, only partial relief.

Furthermore, in order to introduce a shuttle service which would be even approximately satisfactory, it would be necessary to switch at least half the local trains from 14th St. on the main line to the shuttle service across 42nd St. Since the interval between trains on the main line is about 2½ min. during rush hours, it would reduce the service on both the shuttle and the Lexington Ave. main line (above 42nd St.) to 5-min. headway, which would be entirely unsatisfactory in either case. Rush-hour service on all lines should approach 2-min. intervals as closely as practicable.

An alternative would be to deflect half the local trains on the lower east-side line across 42nd St. and then northward on the west-side line, and in turn deflect a corresponding number of trains from the lower west-side line across 42nd St., and thence northward

on the east-side line. This would form a balanced system of operation, and would come nearer to fulfilling the requirements than any other train service which could be proposed, though the shuttle service would still be restricted to 5-min. intervals. In order, however, to make the necessary connections from the lower west-side to the upper east-side line, these plans should have been included in those of the general improvement—if, indeed, they could have been made at all. Now, with the general development which has since taken place, notably the completion of the Hotel Commodore, such connections cannot be made except at prohibitive cost.

The next possibility is utilizing the Steinway tunnel for relief by extending it westward to Seventh Ave. Plans for such extension were considered years ago, and undoubtedly such construction is still possible. But these plans were merely for the convenience of the traffic from Long Island City, and were not intended to fill the purposes of the present shuttle service. The tunnel is too deep for the purpose, and is difficult of access from the street surface.

At Lexington Ave., and again at Seventh Ave., the Steinway tunnel extension must pass below all other subways. It could approach the surface only somewhere midway between these two points; that is, in the vicinity of Fifth Ave. and 42nd St. But here street traffic is already so congested that a further increase is undesirable. Plans for a revision of street grades at Fifth Ave. have been under consideration.

An expenditure of possibly $3,500,000 would be required to construct the Steinway tunnel extension. The present subway section in 42nd St. would be of little value unless use could be made of it as an auxiliary. Some three years were required to construct the 42nd St. subway, and it could hardly be expected that the more difficult Steinway tunnel extension would be built in less time.

Moving Platform Operation

With these three suggestions of train service eliminated, the remaining expedient is the introduction of the moving platform, or a similar device, in the subway as at present existing.

While the introduction of this method of transportation would be novel and would call for the greatest structural and mechanical engineering skill, the system has been investigated by the most eminent engineers of their day and has received their unqualified indorsement. It is the escalator principle of continuous service, applied to horizontal transportation. To object now on the score of its novelty is not "conservative," but rather unprogressive and unscientific. The work should be undertaken, however, only by men of clear vision and of strong mechanical instinct, men who are determined to succeed and who are capable of overcoming obstacles as they appear.

The introduction of the moving platform into the present subway in 42nd St. would save the bulk of the expense of the Steinway tunnel extension. The cost to the city would be nominal. Close connections could be made with the Interborough subways which it is intended to serve, as well as with other subways, if so desired.

In its operation there would be no intervals of waiting between trains, as with car service, since the platform is ever there and ever moving. The traffic level would be nearer the street surface. Entrances and exits could be provided at every street, or, indeed, at every store. Finally, the equipment may be so designed that when it is in full operation and has demonstrated its efficiency it may be extended through the Steinway tunnel, affording continuous passage from Long Island City.

Studies of the moving platform or continuous-train system, made for the purposes of the report to the Public Service Commission in 1909, already referred to, brought to light very significant facts concerning the transportation value of the system. In point of capacity it surpasses the highest demands of present-day

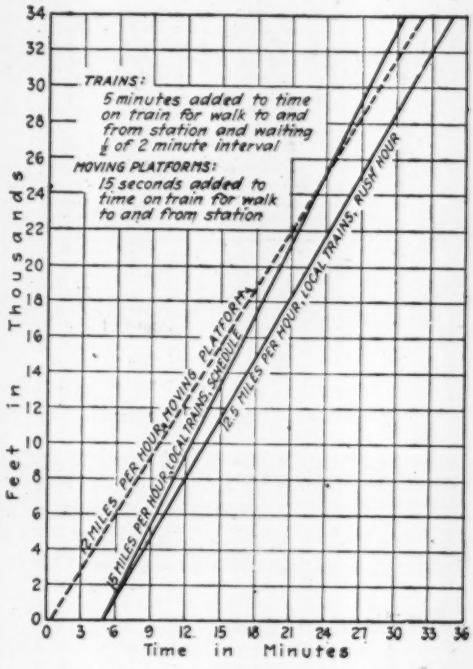

TRAINS:
5 minutes added to time on train for walk to and from station and waiting ½ of 2 minute interval
MOVING PLATFORMS:
15 seconds added to time on train for walk to and from station
RUSH HOUR
MOVING PLATFORM
SCHEDULE
2 MILES PER HOUR, MOVING PLATFORM
5 MILES PER HOUR, LOCAL TRAINS, SCHEDULE
12.5 MILES PER HOUR, LOCAL TRAINS, RUSH HOUR
Feet in Thousands
Time in Minutes
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34
0 3 6 9 12 15 18 21 24 27 30 33 36

FIG. 2. SPEED COMPARISON OF MOVING PLATFORM AND TRAIN

traffic. In point of speed it has the advantage over the present system for all distances up to four miles.

For the speed calculations, data were taken from rapid-transit service as it existed in New York City, average conditions being selected as follows:

Distance between express stations	2 miles
Distance between local stations	½ mile
Distance between cross streets	1/20 mile
Speed of express trains, including stops	25 miles per hour
Speed of local trains, including stops	15 miles per hour
Speed of moving platform	12 miles per hour
Speed of pedestrians	3 miles per hour
Average interval between trains	3 min.

It was assumed that the average passenger starts his journey at a point distant from a local station by one-fourth the spacing of stations, and travels to a point of destination likewise one-fourth the station spacing away from a station. It was assumed that he must wait at the station for a time equal to one-half the interval between trains. These data led to conclusions which are plotted on the diagram, Fig. 2, herewith.

For all distances less than four miles the moving platform is a quicker mode of conveyance than local train service or even local and express service combined. This is true on the assumption of a speed of 15 miles per hour for local trains. But, as a matter of fact, local

service during rush hours averages only about 12 miles per hour, and under these conditions the platform has the advantage over the train for all distances.

Great superiority in passenger capacity is, however, the primary distinction of the moving platform, next to its ability to receive and discharge passengers anywhere along the line. It can carry 73,500 passengers per hour, all seated, against 58,500 passengers for ordinary trains with both express and local service on separate tracks (36,000 for eight-car express trains, 22,500 for five-car locals) of whom only one-third would be seated. Ten years ago the writer reported that "the

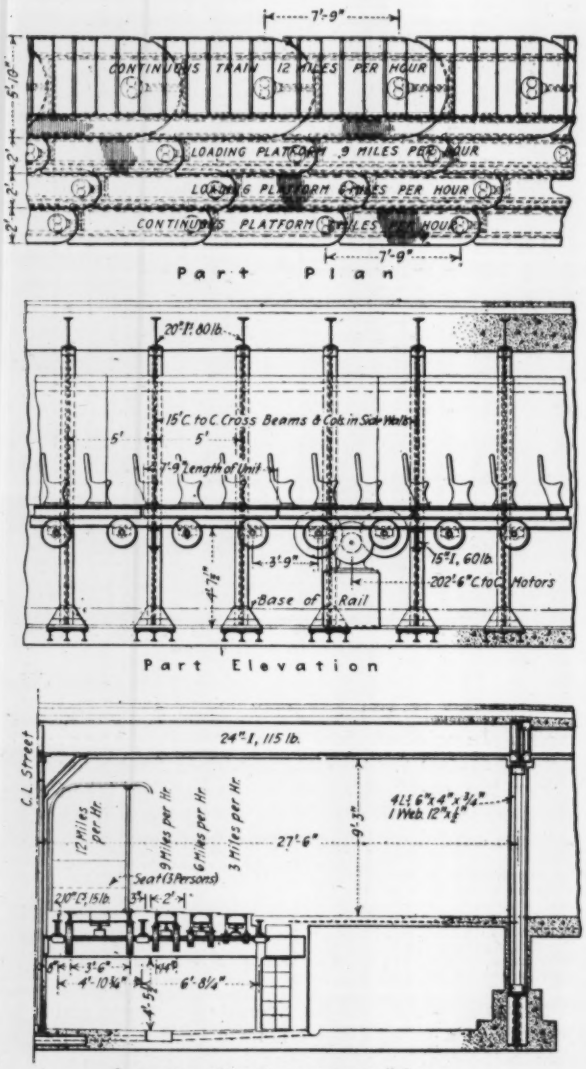


FIG. 3. ADAPTATION OF MOVING PLATFORM TO A SUBWAY DESIGNED FOR TRAIN OPERATION

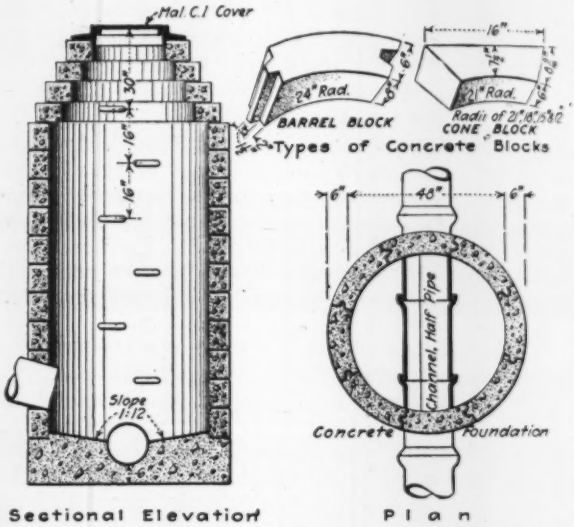
capacity of the moving platforms is beyond any requirements which can at present be foreseen." Though the density of traffic in the New York subways has more than doubled in the interim, this statement is approximately true even today.

Introduction of the moving platform into the future transit system of New York City is inevitable. The channels of subway construction in lower Manhattan are practically filled, and in the increase of travel which will develop the inadequacy of the present transit facilities to accommodate it will become increasingly evident.

Design and Cost of Concrete-Block Manholes for Pipe Sewers

By R. A. Koerner
City Civil Engineer, Terre Haute, Ind.

CONCRETE-BLOCK manholes for pipe sewers, as built at Terre Haute, Ind., in accordance with the accompanying illustration, cost 40c. each, or about $8 per foot of height. The blocks are made of 1:2:4 concrete, with 10% of hydrated lime added for waterproofing. The floor of the manhole is sloped to obviate the remaining of sewage in the manhole when the sewer is running over half full. The same general design is used for catchbasins. So far as known, the design shown is original with the writer, who was led to make it by the exorbitant price demanded for brick.



CONCRETE-BLOCK MANHOLE FOR PIPE SEWERS

Salvaging Construction Material in China

A letter from Donald F. McLeod, professor of railway engineering in the Chinese Government Engineering College at Tangshan, North China, describes an interesting adaptation of local materials to construction in hand. The contractor who dug a large, open well on the campus, 30 ft. in diameter and about the same depth, used for cribbing the stalks of a plant similar to sorghum to hold up the sides of the excavation, together with the surcharge due to the material excavated, until he could get a stone lining in place. He successfully salvaged all his sorghum stalks as the stone wall was completed. The letter continues: "Sorghum stalks are valuable as fuel when they are of no further use for building material. Although there are coal mines here the shafts are deep, about 1300 ft., which makes coal cost $4 per ton; pretty high for a man who gets only 30c. a day in wages. Consequently, nothing in the way of vegetation is despised as fuel, every leaf, every blade of grass being carefully gathered up for that purpose."

The title here used is that employed by Mr. Shenehon. Had we rewritten it we would have called the article, "The Philosophy and Romance of the Engineering Activities of the Minnesota Country."—EDITOR.

The Engineering Activities of the Twin Cities

An Address by Francis C. Shenehon, Consulting Engineer, Minneapolis, Before the Forty-Ninth Annual Convention of the American Society of Civil Engineers, Minneapolis, June 17, 1919

IN interpreting this subject "The Engineering Activities of the Twin Cities," it will be assumed that the Twin Cities are simply the hub of a radiating series of engineering activities, that follow transportation lines southward to the Gulf of Mexico, reach northward to the Lake of the Woods, and, loosely defined, eastward and westward to the Gulf of St. Lawrence and the Red River of the North. You will observe that the engineering activities of the Twin Cities are far-flung!

As I proceed to develop my theme, Sherlock Holmes might discover that my interests and convictions are hydraulic, because *water*, whether I will it or not, recurs and resounds like the burden of an opera.

The early voyageurs, Radisson and Groseilliers, who penetrated the wilderness and reached the prairies of Minnesota, and the Mississippi River in the vicinity of Winona, some miles south of St. Paul, started their pioneering journey at Montreal, proceeded by canoe up the Ottawa River to Georgian Bay, Lake Huron, thence to the inlets along the west short of Lake Michigan; and finally made an overland journey of 150 miles westward to the Mississippi. This was about the middle of the 17th century. These voyageurs prepared no maps of this region. Joliet in 1673 reached the Mississippi by way of Lake Michigan and the Illinois River, and opened a water avenue from the south for French exploration of Minnesota. Almost exactly 240 years ago this time of year, Sieur Duluth landed in the vicinity of the present City of Duluth, and penetrated the inland country of Minnesota to Mille Lacs, about 70 miles from Minneapolis—the first white man to report and record his explorations. Later on the Sieur La Salle, and Father Louis Hennepin (in the summer of 1680) came to St. Paul. Hennepin went on to the cataract to which he gave the name of his patron saint, Anthony of Padua. The Dakota Indian name for St. Anthony Falls was Minni-i-ha-ha—"the rushing water"—a name now transferred to the smaller falls immortalized by Longfellow, Minnehaha—"laughing water."

"Exploration Engineers"

These pioneers were *Exploration Engineers*, and their activities have had to do with present engineering activities in the Twin Cities—and they reached here by water transportation in birch-bark canoes. The motives of these exploration engineers, engaged in a reconnaissance survey for the advance of civilization across a continent, were mixed. The inculcation of religion in pagan souls, the extension of imperial domains, fur trading, adventure—and the search for a westerly passage from France to China—all had a part. The naming of the St. Lawrence Rapids at Montreal, Lachine Rapids—or "the Chinese rapids"—illustrates the geographical misapprehension as to the nearness of the Orient, which was actually more than 8000 miles toward the sunset. It is said of Nicollet, "so confident was he of reaching China that he took with him a gorgeous mandarin's robe of damask to wear at his court reception."

This Minnesota country, penetrated by these exploration engineers, was inhabited by savage peoples—Indians—whose chief engineering activities were military—eternal warfare. They subsisted by hunting and fishing perhaps more substantially than by agriculture. Wild rice grew in marginal shallows of the lakes and rivers, wild fowl fed on the wild rice; moose came to the water, as cattle do, to drink, keep cool and avoid fly pests; fish abounded; the streams were avenues of transportation—hence aboriginal populations kept close to the waterways.

Where French and Indian Met

It is rather astonishing how this dependence on lakes and streams is reflected in Indian names, which now exist as geographical permanencies. Minnesota means blue or misty water. The name was first applied to the Minnesota River, and then taken over by the state. Missouri is Dakota for turbid water. Mississippi is Algonquin for far-reaching waters. Minnetonka means Great Water. Minneapolis is a half-breed name—Indian mother, "Minne," waters, Greek father, "polis," city—hence, the City of Waters. These recurring Indian names, and the French names Radisson, Hennepin, Nicollet, La Salle, Joliet, Frontenac and Duluth, still keep vivid the color of two centuries in which the picturesque glories of the French civilization met, by forest and prairie, the ancient, unprogressive, but picturesque, savagery.

My conception of a civil engineer is that he is a surgeon operating upon the earth as his patient; and in developing my subject it appears desirable to touch very lightly, and very briefly, on an activity, essentially engineering, which preceded the Indian and the French in this region. The Panama Canal in some form might ages ago have been cut by geologic action, without the guiding hand of the engineer as we know him. And this surgical operation successfully completed at Panama has done a thing which we find in other places already done for us by sure, slow, constructive geologic forces directed by the Engineer of the Universe. The problems engineers deal with today are inextricably and fundamentally dependent on natural evolutions and physical changes of the past. We take up the task at the point to which Nature has already brought it, and accelerate, retard or modify the project. We are in partnership with every elemental physical force of the universe, and each one of us likes to think of himself as the dominant senior partner.

Geological agencies conferred on Minnesota vast stores of hematite, the blood-red iron ore. Perhaps an account of the genesis of this deposit, the succession of events resulting in making it accessible and commercially worth while, will be of interest, particularly to those who are to visit the Iron Range. About 41%

of the crust of the earth is iron; and every stream entering the ocean carries to this omnibus catchment basin a small contribution of this metal. It gradually precipitates in the deep sea bottom, securing oxygen and carbon in part from animal and vegetable organisms, until after countless æons great beds of ore are laid down. Then as the earth cools state-wide slabs of crust are reared above the sea level. A glacier scrapes off and truncates this pyramidal mass. Now, this hematite, as it came out of the sea, was not commercial ore, it was only about 30% iron. But, exposed to the elements, it weathers. The oxygen and carbon in part disappear, while all iron remains, until enrichment is complete, and the ore is commercially good, with 50% or more of iron.

The geological formations exposed in the Mississippi River gorge are interesting in their genesis, and tremendously important to the Twin Cities as bearing on present engineering activities.

Down underneath is the St. Peter sandstone several hundred feet in thickness. This is made up of fine, rounded grains of white sand imperfectly cemented with porcelain clay. This sandstone is so soft that you can carve your initials in it with your finger nail. It is porous and contains in part the artesian reservoir of water. On top of the sandstone are 4 ft. of blue shale, and above this about 30 ft. of limestone; then on top glacial drift, about 30 to 40 ft. of a mixture of sand, gravel, boulders and clay.

The sand was deposited ages ago in the sea, near shore in shallow water; then the bottom of the sea subsided, and in the deeper water the finer sediment, mud with some lime and some organic life, formed shale; the bottom of the sea was then further depressed, and in the deep sea, far from offshore sedimentary deposits, the pure hard limestone formed, imprisoning in its solidifying grip the organic dead. Then the ice sheet, a mile thick over this region, melted and left the rock débris, which we call glacial drift.

Might Have Been No Minneapolis

The significance of these geological formations is shown by the recession of the Falls of St. Anthony from somewhere down in Iowa to its present location in Minneapolis. The destructive force of the falling water successively cut out the soft sandstone, undermining the limestone ledge, toppling it down, and permitting the persistent northward travel of the falls, with the ever-lengthening gorge. If civilization and engineers had been in Minnesota some thousands of years ago, the water-power might have been caught and held at St. Paul, and there would have then been no Minneapolis! Minneapolis itself nearly lost the water-power by northward recession of the falls some forty-odd years ago. But engineers terminated the freedom of geologic action, built a great cut-off wall of concrete to protect the sandstone, and directed the flood waters over a timber apron. The engineeering activities of that day, in this arresting the recession of St. Anthony Falls, makes an interesting chapter in local history. The Mississippi River for sixty miles above Minneapolis has its channel in glacial drift. The high dam in the gorge below is founded on glacial drift mixed with fragments of limestone, while the power house and the vessel lock, at the two ends of the dam, are founded on the sandstone.

The Third Avenue bridge, a monumental recent engineering construction, is founded on the limestone ledge.

The sandstone formation is readily tunnelled, and Minneapolis and St. Paul, in particular, utilize this very fully for sewers.

With this historic and prehistoric background, the story of more recent developments and present engineering activities should be more understandable.

Navigation and City Location

In the days when Minnesota was on the lonely frontier, St. Paul grew to be its most populous city and later its capital, because it was at the head of practicable steamboat navigation—a water reason. Contrary to the rule of growth of cities, which fixes them a day's journey apart, Minneapolis grew into our largest city, centering about the great water-power here—a descent of about 48 ft. in a cataract in the Mississippi River, with over 20,000 available horsepower—another water reason. Another city, Stillwater, grew up at the virtual head of steamboat navigation on the St. Croix River, a tributary stream of the Mississippi, which is the trunk line of navigation leading to the Gulf of Mexico.

In passing, it may be of interest to note that in the division of spoils in state institutions St. Paul received the desirable capitol, Stillwater the desirable penitentiary, and Minneapolis the then doubtful university, all now centers of engineering activities.

Minneapolis and Stillwater had a kinship in the fact that a form of navigation, much exceeding the steamboat in importance, existed in the floating of logs on the upper Mississippi and the upper St. Croix, which, with their many tributaries, found their headwaters in the heart of limitless forests of pine, hemlock and cedar. At Minneapolis the forest products met water power which, with steam power, converted logs into lumber. At Stillwater steam sawmills operated and the logs were also rafted, to continue their journey southward. The floating of logs was the most considerable navigation which the Mississippi River through the State of Minnesota has ever known. It is a familiar fact that a stream which does float logs, and crosses a state boundary, ceases to exist only as a child of the state in which it has its source, but becomes a ward of the Federal Government, subject to all the limitations and advantages which this implies. The transportation of logs and the cutting up of logs in the past have been essential and important engineering activities, which now have practically vanished with the near destruction of the forests.

The water powers at Minneapolis and in the vicinity are the present dominant natural elements, which create engineering activities, which in turn supply other engineering activities. For the future, when population is dense enough, river navigation promises to mean much for Minneapolis, St. Paul, Stillwater and other river cities.

At the present time, by the building of the high dam and lock between Minneapolis and St. Paul, the actual head of navigation for steamboat service on the Mississippi River is brought to Minneapolis. The construction of this vessel lock and dam is one of the fairly recent engineering activities of the Twin Cities. The evolution of the project from a two-lock scheme, which neglected the water power (10,000 horsepower) inevitably present, marks the transition of the Federal Government from the rôle of navigational proprietor

alone, blind to other uses, to the larger rôle of master of navigation and water power both. It is a little discouraging, however, to note that three years, during the war period, when our railways were congested getting coal to this water-power city, much steam-generated power was in use and coal consumed, while potential power equivalent to perhaps 50,000 to 100,000 tons of coal a year was wasted through the sluiceways or over the crest of the dam. The dam itself is of the Ambursen type, with normal 30-ft. head, with power-house foundations built contemplating a use of 6000 cu. ft. per second in generous river stages. The use of this power awaits action by Congress on a general water power bill.

The main 48-ft. drop at St. Anthony Falls is largely used for grinding flour, the most important engineering activity of Minneapolis. The flour mills have a story of their own, and this will be told at the mills to visitors. The annual production of high-grade flour ranges from 16,000,000 to 20,000,000 barrels.

Half a mile downstream from St. Anthony Falls, a second development exists with a fall of 18 ft., used by the local traction company.

Power Auxiliaries Needed

As the flow of the Mississippi River sometimes dwindles to 1000 cu.ft. per second in mid-winter attenuation, great steam auxiliaries are everywhere supplied. The Riverside station of the Minneapolis General Electric Co. with its recently installed 25,000-kw. turbo-generator, is the most colossal auxiliary of the Twin Cities, supplying current to the mills and other manufactories, and to public utilities as well, in times of low river flow.

The water power plants and water power sites of the Northern States Power Co. on the Mississippi and St. Croix Rivers represent engineering activities, existing and of the near future, of great interest. The Main St. station develops a portion of the St. Anthony Falls power. The Coon Rapids dam, with 18-ft. head, completed in 1914, is on the Mississippi River about 11 miles above Minneapolis. The Taylor's Falls plant of this company, on the St. Croix River, about 41 miles by transmission line from Minneapolis, has a fall of 60 ft., and 20,000 installed horsepower, mostly used in the Twin Cities for manufacturing and public utilities. The undeveloped dam sites of this company on the St. Croix and Mississippi Rivers represent in their future development problems of exceeding interest. Some of these dams will be on rock foundations and some of them will mean 30 or 40-ft. heads on glacial-drift foundations; which will call for most skillful planning and execution, and will doubtless, when constructed, mean long strides of advance in the art of dam building on porous foundations.

No summary of the engineering activities pivotal on the Twin Cities can omit mention of the great head-water reservoirs of the Mississippi River. These reservoirs have utilized two large and several smaller natural lakes. Their combined capacity is over 100,000,000,000 cu.ft., with a watershed area of about 4000 square miles, and an additional water area of over 400 square miles.

Controlled by the Federal proprietor, who by law must regard navigation, however little it is, as the predominant interest to be served, the release of water is not always beneficial to the water powers, and sometimes is detrimental, as in midwinter when power needs are great and river flow meager. The water powers are really at the present time a greater public resource here than navigation itself. The benefit in vessel draft is about 1 ft. at St. Paul, tapering off to zero perhaps a hundred miles downstream. I imagine it will require an act of Congress to modify the release of reservoir storage so as to give the maximum benefit to the important water powers of the Mississippi. The attitude of the Federal proprietor is likely to change when the Federal water power at the high dam becomes a beneficiary.

The things discussed thus far represent engineering activities which are inherent in the physical and geographical characteristics of the Minnesota region. The existence of these things has caused great aggregations of people to cluster here. This population must be served by many engineering activities. Railways must bring to them many things to supplement the regional products, and must take away the things produced here. Minneapolis and St. Paul are two beads threaded on five transcontinental lines; and four axial north-and-south lines reach toward the Canadian store house and the cotton belt. Locally we are excellently served by a traction system which is suffering from 5-c. fares and franchise uncertainties.

Water-Supply

The water-supply here cannot fail to represent an engineering activity of transcendent interest — more particularly after July 1. The Mississippi River which has served so efficiently in the past in bringing forest production to Minneapolis brings also the sewage of the City of Anoka, 20 miles upstream. Minneapolis uses the Mississippi River, as it departs southward, to convey its sewage to St. Paul. These two facts made Mississippi River water a bad beverage for Minneapolis, and an impossible source of water-supply for St. Paul. Up to 1912 Minneapolis did pump its domestic supply unpurified from the river, notwithstanding the malign contributions from Anoka. Well-to-do people bought spring water crystalline clear in bottles. Venders sold water as they now sell milk—only seven years ago. The poor and the careless had winter cholera and typhoid fever. The first civic awakening dosed the water with chlorine, which helped while the present mechanical filtration plant was planned and constructed. Investigations for a better water-supply gave consideration to four possible sources. Lake Superior, 140 miles away, was alluring. Mille Lacs, a lake 207 square miles in area, 70 miles away, was enticing. The subterranean artesian supply, rising by gravity to perhaps 100 ft. below the street level here, had many advocates. The Mississippi—"a poor thing, but our own"—could not be overlooked.

The investigations resulted in the rejection of the Lake Superior source as too distant, the Mille Lacs supply as inadequate, the artesian as too hard and too uncertain, and the acceptance of the sometimes turbid, sometimes defiled, but always adequate, Mississippi River water, which by skillful engineering processes has been relieved of its baser ingredients and converted into a crystalline, wholesome supply. The typhoid rate in Minneapolis is singularly low. Schools and hospitals freely use the domestic supply for drinking purposes.

and all persons may meet confidently the era of alchoholically dry days.

St. Paul secures its water-supply from a group of lakes, reinforced by the artesian flow.

In concluding this meandering talk on the things conceived as of vital engineering interest to the Twin Cities and their zones of influence, I wish to speak for a few minutes of the most important inland navigational resource of the world, which now brings steel vessels built on the Clyde in Scotland to our Minnesota harbor at Duluth. As the Mississippi River gives Minnesota a water route to the Gulf of Mexico, the Panama Canal, the Pacific Ocean and the Orient, so the Great Lakes lead to the Gulf of St. Lawrence, the blue Atlantic, England, France, the Mediterranean, the Suez Canal and the Indies. Minneapolis is at the utmost inland reach of the Mississippi, and Duluth at the utmost inland reach of the Great Lakes.

Nowhere exist such alluring, splendidly big engineering things, solved and unsolved, as in this chain of magnificent lakes and stately rivers. It has been my privilege to have had a part in the things solved, and it is still my privilege to work on the things unsolved, and I regard myself as peculiarly blessed in working within such far-reaching horizons.

The hematite ore of Minnesota is vitalized and made marketable—80 per cent of the whole country's supply—by this waterway, which carries the ore to the coal, and brings coal to some of the ore smelted at Duluth. It is probable that the bulk of this ore would lie unmined and unused were it dependent on rail transportation. It costs roundly $1 a ton to get the ore by rail 100 miles from the Missabe Range to the lake shore at Duluth, and it costs $1 to cary this ton of ore 1000 miles to Buffalo.

The tonnage passing the big ship locks in St. Mary's River, at the foot of Lake Superior, exceeds the combined tonnage of the Panama and Suez Canals.

Exit to the sea is still limited by the shallow drafts of the Erie, Welland and St. Lawrence Canals. But the Welland Canal is building now for 25-ft. draft in the canal prism and 30-ft. draft in the locks; and the St. Lawrence waterway will follow this lead. That is one of the big engineering things. The New York State Barge Canal shrinks to a trifling thing, with these great projects evolving.

The Chicago Drainage Canal, diverting a considerable stream of Lake Michigan water, has created the need of the regulation of Lakes Michigan, Huron, Erie and Ontario, by controlling work in the outflow rivers—Niagara and St. Lawrence in particular. St. Mary's River, the outlet of Lake Superior, is already under artificial control, in the interests of navigation and water power; and projects are maturing for the manipulation of the outflow in the Niagara and St. Lawrence Rivers. Each year, to a greater extent, it is realized that after all the lakes are storage reservoirs of almost limitless capacity and incalculable value. Nature has one sole motive in her operation of the outflow rivers, which is to rush the waters to the sea. The water returns through the heavens, and the endless cycle of rainfall and outflow goes on. But this water, when engineers intervene, must be made to serve better the artificial uses of navigation and power.

So it will come to the point where we must *budget* the water eventually—why not now?

Budgeting the water means spending it systematically and scientifically, in well thought out apportionments, which will make the Niagara and the St. Lawrence better navigable ways and better water power streams.

Water power is really the thing which inflames the imagination. Aladdin with his lamp never conjured genii to serve him so omnipotent as engineers have made emerge from seaward-bound waters. And the Niagara and the St. Lawrence descending to the ocean held in their depths potentialities to assume tremendous burdens of labor which still pitilessly strain human muscles.

In these things of which I have spoken I conceive to be in the largest sense the significant engineering activities of the Twin Cities.

Results of Long-Time Tests of Creosote-Treated Fence Posts

By C. H. Teesdale
Engineer in Forest Products, Forest Products Laboratory, Madison, Wis.

OVER 2000 fence-posts were treated and set during 1908 and 1909 by the United States Forest Service, in coöperation with the University of Minnesota. Quite a number of these posts were treated with water-gas-tar creosote and others with coal-tar creosote, the hot and cold bath open-tank method being used and the entire post treated. An inspection in the summer of 1918, 9½ years after the posts were set, gives some interesting information, as it affords a direct comparison between coal-tar creosote and water-gas-tar creosote as wood preservatives. The table gives results from three inspections of these posts in 1913, 1916 and 1918.

BASSWOOD AND RED OAK POSTS TREATED BY COAL-TAR AND WATER-GAS-TAR CREOSOTE

Treatment	Species	Years of Service	Inspected	Number Tested	Good, %	Partly Decayed, %	Badly Decayed, %	Removed Account Decay, %
Coal-tar	Basswood	4½	1913	458	93.0	6.3	0.5	0.2
Creosote	Basswood	7½	1916	484	87.0	9.5	3.1	0.4
Creosote	Basswood	9½	1918	337	73.5	17.4	4.4	4.7
Water	Basswood	4½	1913	35	100.0	...	...	...
Gas-tar	Basswood	7½	1916	36	86.0	8.3	5.6	...
Creosote	Basswood	9½	1918	27	78.0	14.7	7.3	...
Coal-tar	Red Oak	4½	1913	226	100.0	...	...	...
Coal-tar	Red Oak	7½	1916	325	99.2	0.8	...	...
Creosote	Red Oak	9½	1918	330	94.5	1.8	1.2	2.5
Water	Red Oak	4½	1913	42	100.0	...	...	...
Gas-tar	Red Oak	7½	1916	98	97.0	1.0	2.0	...
Creosote	Red Oak	9½	1918	93	92.5	5.4	...	2.1

It is seen that at the last inspection 73.5% of the basswood treated with coal-tar creosote and 78% of that treated with water-gas-tar creosote were still sound. In the case of red oak 94½% treated with coal-tar creosote and 92½% treated with water-gas-tar creosote were still sound. It was found that the basswood posts did not take the treatment well, and for this reason this species is not recommended for open-tank treatment.

River Water Treated for Compensation Supply

To fulfil its obligations to supply compensation water to satisfy riparian or power rights, the City of Sheffield, England, will treat 9,000,000 Imp. gal. of Don River water per day to fit it for industrial use and pump it 11 miles back into the Loxley and Rivelen Rivers, tributaries of the Don. The water will be taken from the Don below Sheffield. Parliamentary authorization was required, and the committee hearing occupied 13 days. The London *Surveyor* states that this is new principle as to compensation water.

Enlargement of the Yakima-Tieton Main Canal

Half Circular Section of Reinforced Concrete Increased in Height—Bonus System Successful in Overcoming Great Scarcity of Labor at Favorable Cost

By G. C. Finley
Engineer United States Reclamation Service, Yakima, Wash.

Upon the extension of the boundaries of the Tieton Project of the Reclamation Service in the State of Washington from 24,000 acres to 32,000 acres, it became necessary to increase the capacity of the Tieton Canal. The reinforced-concrete section of this canal was circular, open at the top, slightly exceeding a semi-circle in cross-section. To enlarge the canal, a new top segment on each side was cast in place after the old concrete bracing ties were removed and a notch was cut for bonding the old to the new concrete. An acute labor situation was successfully met by introducing a bonus system, which also resulted in more than doubling the amount done per day, making possible the completion of the work, as desired, last fall.

The Tieton Canal was constructed by the United States Reclamation Service during the period from 1907 to 1909, and has been used to carry water for irrigation for the past eight years. The Tieton project, to which this canal supplies water, covers 32,000 acres, of which 26,000 acres are in a high state of cultivation. This past season there was produced $2,500,000 worth of foodstuffs, and the water duty was 2.36 acre-feet delivered on the farms.

The canal was originally constructed of reinforced concrete in sections on the flats along the river, the sections being transported to the canal site, then placed and grouted together. The sections were circular in form, 8 ft. 3⅜ in. in diameter, the top edge being 22 in. above the horizontal diameter and tied together by a 4 x 6-in. reinforced-concrete bar. They were built 2 ft. long and 4 in. thick, reinforced with ¼-in. steel longitudinally and ⅜-in. circumferentially.

The canal varies in elevation above the river from 0 at the point of diversion to 500 ft. at the lower end, and is constructed along a very rough and precipitous cañon wall. Fig. 1 shows a section of the original canal as completed in 1909.

Enlargement Necessary—The canal was designed and constructed for a project of 24,000 acres, but the boundaries of the project were subsequently extended to embrace 32,000 acres. This increase in area and a growth of algæ which reduced its capacity somewhat made it necessary to enlarge the canal section to carry the required quantity of water. The enlargement of the entire canal was begun in the fall of 1916, was continued in the fall of 1917 and then finally completed in the fall of 1918. Due to weather conditions in the Tieton Cañon and the necessity for continuing the operation of the canal, the working season was only from the first of October to about the middle of November, or about seven weeks each year.

FIG. 1. ORIGINAL CANAL SECTION AS COMPLETED IN 1909

FIG. 2. TRANSPORTING CEMENT BY TRAMWAY

The necessary materials consisted of cement, sand and gravel, structural and reinforcing steel, and lumber for forms. The cement, steel and lumber were hauled by motor truck from Naches, an average distance of 15 miles. The aggregate was all hauled by teams from various points along the river, either direct to the canal or to the foot of tramways. The sand was screened through a ¼-in. mesh, and the gravel passed through a 1½-in. mesh. Fig. 2 shows how the cement was transported at one point of the canal by inclined track and tramway.

One of the big problems was the distribution of material along the canal. There were various parts of the canal up to 1½ miles in length where materials were delivered at only one point. This distribution was made by using mules hitched to small cars, as in Fig. 3. This work was first attempted by using men and cars, but the mules after the first few days were found to haul more load and make better time. The small stream of water shown running in the canal was used for the hoist boiler and for mixing concrete.

The preparation for joining the new work to the top of the original canal meant the removing of the concrete crossbars and the chiseling of a groove along the top of each side of the canal. This chiseling was first done by hand, but later by using two small pistol-grip

FIG. 3. MULES AND SMALL CARS USED FOR DISTRIBUTION OF MATERIAL ALONG CANAL

drilling machines run by an air compressor, operated by hand. Fig. 4 shows the canal as prepared for the enlargement. The hammers used for chiseling along the canal were found to work very successfully, in time and cost.

The old concrete crossbars were broken up and used for aggregate, and the reinforcing steel was salvaged. The new crossbars were made from 3-in. standard channels spaced 5 ft. apart and extended 6 in. into the old concrete. No provision for a contraction point was made in the new work, as 1% of temperature steel was provided and the work was all done during cool weather. To date there have not been any serious temperature cracks in the entire canal. The addition as constructed gave the canal a certain longitudinal strength as a beam, which may be of value in case of undermining. The maintenance work on the repair of the joints each season, due to temperature, has been materially reduced. Fig. 4 gives the general dimensions and details of the enlarged section.

Form Construction—Forms made of 1-in. surfaced cedar were used for the work and placed to grade by using a Y-level. The inside surfaces were all pointed with linseed oil twice during each season. Fig. 5 shows how the forms were placed, also the structural and reinforced steel and materials as they were placed.

Fig. 6 shows the manner in which the concrete was mixed and placed. The work was carried on by a number of crews of about 18 men, each in charge of a foreman. Each crew used about 600 ft. of forms, of which about 250 ft. were removed each day and moved ahead and refilled. The mixing and placing were all done by hand, the mix being 1:2:4 with sand and gravel aggregate. The mixing was done on a board supported above the canal by wooden horses which were moved forward along the canal. The concrete when mixed was shoveled direct into the forms. The forms were removed in 48 hours, and, because of careful mixing and tamping very little finishing was found necessary. The original canal was raised by placing the forms tangent to the curve a sufficient distance to make 1 ft. in elevation. The progress of the work from the beginning in 1916 until the close in 1918 varied per crew from 140 to 400 lin.ft. of canal per day.

Fig. 7 gives a view of the present completed canal, showing the steel crossbars, new work and the point of contact between the original canal and the enlargement. The capacity has been increased from 300 cu.ft. per second to about 350, which will be sufficient for the full development of the project.

Weather conditions during the working season on the

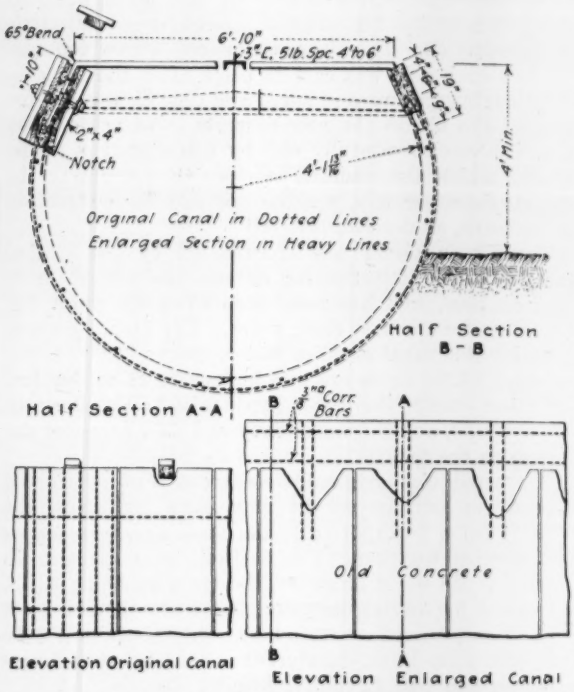


FIG. 4. DETAILS OF ORIGINAL AND ENLARGED SYSTEMS

canal were generally favorable, and especially during 1918 the weather was perfect, with no time lost on account of rain and no concrete damaged on account of cold weather. There was an average of 12 hours daylight during the working season.

Labor Situation—The local supply of labor during 1918 decreased rapidly from early spring on account of shipbuilding, logging and other war industries offering high wages on the coast, and, beginning with the need for farm labor in the valley about June 1, the labor situation in general began to look very serious for construc-

FIG. 5. BRACING AND FORMS IN PLACE

tion work of any kind. Wages were increased about 50%, which made the cost almost prohibitive.

The only time during which the enlargement work on the Tieton Canal could be done was the month of October and the first half of November. This was during the time when the farmers were harvesting their third cutting of alfalfa and practically the entire apple and potato crops, all three of which are produced in large quantities in the Yakima Valley. Prices for farm crops in general were most favorable, so that farmers were paying almost any price in order to obtain sufficient

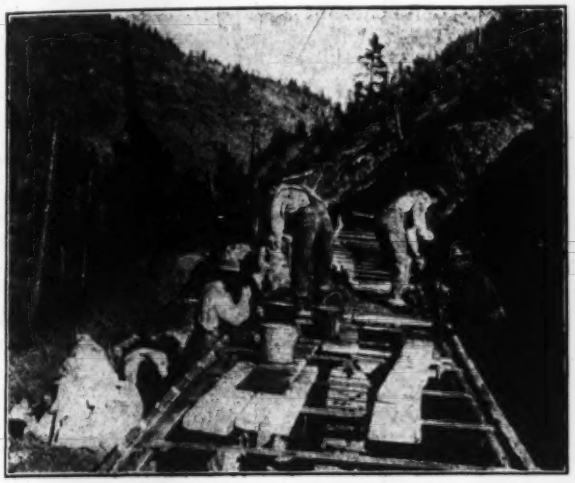


FIG. 6. HOW CONCRETE WAS MIXED AND PLACED

labor for harvesting these crops. Concrete work, especially where the mixing is done by hand, is not attractive to the average laborer because everyone knows it is hard work. Furthermore, a similar job was in progress where wages and living conditions were favorable, only about one-third the distance from Yakima, and this camp was not able to obtain sufficient men.

The estimate of the number of men necessary to complete the remaining work on the canal in the time required was about 160. This meant five crews of about 18 men each, mixing and placing, and the necessary labor to supply material. There were about 40 men in camp who were doing such preliminary work as building roads, erecting a tramway, building forms and screening sand and gravel. On Oct. 1 we were in need of about 120 more men. Labor for construction work in the Yakima Valley is obtained through Spokane and Seattle; many make Yakima their local headquarters.

Bonus System—In order to assist in the solving of the problem of getting sufficient labor while weather conditions were favorable, a bonus system of wages was adopted. The work had been started in 1916 and continued in 1917, and the plans were to complete the job in 1918. There were 126 stations completed in 1916; 97 stations in 1917, and 254 stations remaining. There had always been a labor shortage on this work, but especially during 1917. In 1916 the average progress was 150 ft. per day; in 1917 this average was brought up to 160 ft. per day.

As is the practice in establishing a bonus rate, the cost is divided equally between the employer and employee for any amount of work done over and above what is considered an average day's work, amounting to about 3c. per man per foot. Laborers must have a

COST OF ENLARGEMENT WORK—TIETON MAIN CANAL

	1916	1917	1918	Total
General Costs				
Stations enlarged during year	126	97	254	477
Number of yards of concrete placed	433	333	874	1,640
Cement delivered	$2,926.36	$2,373.34	$4,767.87	$8,567.57
Sand and gravel delivered	4,292.25	3,491.71	7,679.55	15,463.51
Forms, labor and materials	2,583.61	1,655.82	6,632.71	10,872.14
Mixing and placing concrete	1,921.22	1,881.47	11,535.61	15,338.30
Finishing and protection	666.47	759.39	2,715.97	4,141.83
Equipment charge	831.46	375.77	1,854.73	3,061.96
Unit Costs				
Cost of cement delivered in barrels	$3.85	$4.10	$4.15	.....
Lumber delivered—per thousand	11.00	.....	17.00	.....
Wages paid for labor—base rate	2.40	3.00	4.50	.....
Cost of reinforcing steel—per lb. in place	0.045	0.054	0.062	.....
Cost per cubic yard of concrete	30.54	31.64	40.26	35.00
Final Costs				
Preparation, chiseling, etc	$1,793.87	$1,995.37	$7,458.03	$12,747.27
Reinforcing steel in place	1,175.52	1,101.29	3,738.40	6,015.21
Steel crossbars	5,656.11	6,137.41	12,276.76	24,070.28
General expense	1,595.40	2,146.36	5,268.44	9,010.20
Total cost of work	23,442.27	21,917.93	63,928.07	109,288.27
Cost per lineal foot of canal	1.86	2.26	2.52	2.30

The cement haul was by teams in 1916 and 1917, an average distance of 18 and 16 miles. In 1918 motor trucks were used and the average distance was only 10 miles.

No lumber was bought in 1917, old forms being used.

Structural steel purchased in 1918 was 1½-in. reinforcing steel and not 3-in. channels, as previously used, because it was impossible to purchase the standard channels.

certain amount of bonus in order to become interested, and it was decided that 140 ft. per day should be counted as a good day's work. Therefore, each man in the crew received 1½c. per foot each day for any amount completed over 140 ft. The granting of this bonus was contingent on a man working 10 days, and the amount of bonus was determined on each 10-day period.

During the first two bonus periods the average amount of work was about 200 ft. per day. During the third bonus period this average was brought up to 220 ft. per day. The interest in this system of paying for work seemed to grow from the beginning of the work, and during the last period, which was from Nov. 10 to the date of completion, Nov. 18, 1918, the average

FIG. 7. COMPLETED CANAL SECTION AFTER ENLARGEMENT

was 300 ft. per day, with a maximum of 404 feet.

Without a doubt, the result of this system of wages was very material in obtaining sufficient men to complete the work. This scarcity of labor was such that only three crews were working until Oct. 25, and four crews from this date until the completion of the work. There was an increase daily of the number of men in camp from 40 at the beginning of October to a maximum of 160, the increase being gradual. There was very little trouble in holding the men on the work, as wages in general were good and so was the mess.

Figuring the cost of the work done in 1918 carried out under the prevailing wages without bonus, using the work done in 1916 as a basis, it amounts to $3 per lineal foot, which was the estimate prepared for the work. The main result of the bonus system was that it proved to be a sound basis for productive efficiency. The entire canal was completed, and the figures show that the advance in costs in 1918 is considerably below the general advance in labor and materials.

The work was done under the supervision of R. K. Tiffany, project manager of the Yakima Project, with the writer as engineer in direct charge of the work.

Save $10,000 by Breaking Old Stone Across the Bed

Salvaged stone from an old boiler house at the river pumping station of the Louisville Water Co. was broken across the bed and its use on the new boiler house under erection has saved $10,000.

The old structure was 75 ft. square and 25 ft. high, and built of solid stone from Bedford, Ind. The new one is 75 x 150 ft. in plan and varies in height from 25 to 85 ft. It is similar in construction to the pumping station described in *Engineering News-Record* of May 9, 1918, p. 905, being faced with 6 in. of stone and backed up with reinforced concrete. The stone in the old building varied in thickness from 6 to 8 in. and in length from 3 to 4 ft., all being headers 2 ft. wide, faced on both inside and outside. Thus, hauling the stone six miles each way to the mill for sawing and refacing would have entailed considerable expense, making the cost practically the same as that of new stone. All of the stones were laid on their beds, and every stoneman who passed on the work said it could not be split across the bed except by sawing and drilling. The best price obtainable for sawing and refacing with a rock face and loading on cars at the factory was 57c. per cubic foot. The 25,000 cu.ft. has been done, according to J. A. Wilson, chief engineer and superintendent for 14c. per cubic foot with little breakage.

The splitting of each stone into three pieces was done by laying the piece to be broken on a bench made of 12 x 12-in. timbers, placing under the stone a ¾-in. iron rod and striking 6 to 10 blows with a 12-lb. hammer.

Calcium-Chloride Solution and Setting of Concrete

Results of Numerous Tests Show That Strength of Concrete Is Not Lowered—Hastens Setting Materially

CALCIUM-CHLORIDE solution materially hastens the setting of portland-cement concrete, and new tests have shown that up to the end of one year the strength of the product is not injured, according to the annual report of H. Eltinge Breed, until recently first deputy commissioner of highways, New York State Highway Department, and now consulting highway engineer, New York City.

In leading up to the portion of his report reproduced below, Mr. Breed stated that, although the department had had unusual success in doing its own construction work upon its unfinished contracts—in fact, so successful that the question is raised as to whether it might not be advantageous for highway departments to be authorized and prepared in emergencies to do their own construction as well as engineering work—still, he felt that perhaps the best contribution made this year by his department to the good-roads movement in the state and elsewhere was through the medium of its research work.

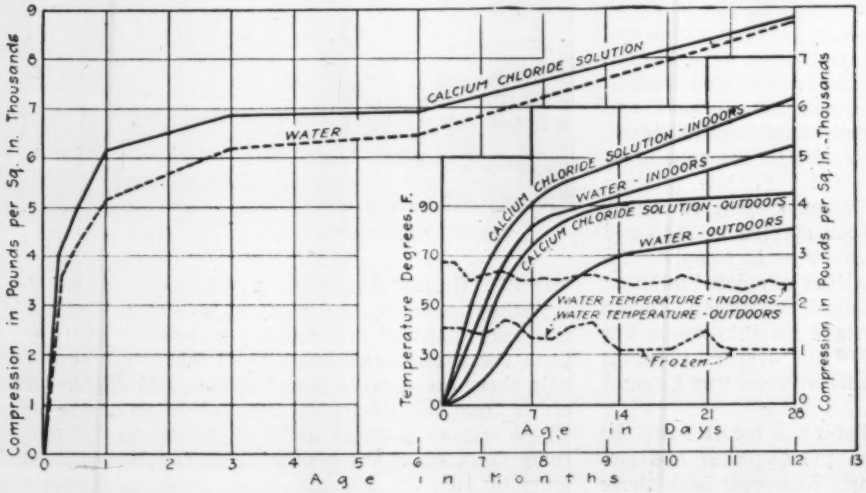
Important phases of this research work are the impact studies, described in *Engineering News-Record*, June 5, 1919, p. 1103, and the experiments with calcium-chloride solution. The following is an extract from Mr. Breed's report referring to the latter:

A series of tests were completed to determine the advantages in use of calcium-chloride solution to hasten the setting of cement concrete. It has been stated that by use of this solution concrete gun foundations could be put in use three days after construction. The tests made by this department were for the purpose of determining whether the rapid setting would decrease the ultimate strength which the concrete would attain. It is well known that abnormally quick setting cements do not usually make concrete which is as strong ultimately as the slower setting cements.

Laboratory test samples were prepared and tested at ages varying from one day to one year. The results are shown graphically herewith. They indicate the use of a 4 per cent. solution of calcium chloride as mixing water for cement concrete increases the strength attained at all ages up to one year.

Beyond that it is still problematical, but what evidence we have indicates certainly no deterioration, and a probable continued, but slower, gain. The maximum increase appears to be about 20 per cent. at the age of one month.

The importance of this determination will be appreciated when it is considered that by the use of this solution it will be possible not only for the contractor but also for the public to make use of cement-concrete pavements a few days after they have been laid, without risk of damage. It will mean the completion of much work in the autumn which has hitherto had to wait over unfinished until spring.



STRENGTH OF CONCRETE WITH AND WITHOUT CALCIUM CHLORIDE.

Sinking and Concreting Mine Shaft 936 Feet Deep

Lining and Walls of Four-Compartment Shaft No. 5 of Miami Copper Company Concreted Simultaneously With Excavation Operations—Blasting Impossible Below 200-Foot Depth

By Richard L. Russell
Superintendent, The Foundation Company, Miami, Ariz.

SEVERAL novel details in underground construction were developed and applied in the sinking and concreting of shaft No. 5 of the Miami Copper Co. at Miami, Ariz. This shaft has four compartments and is 936 ft. deep, and the concrete lining was carried on at the same time as, and without interference with, the sinking, 700 ft. of the shaft lining having been placed and two large stations having been excavated and concreted by the time the shaft had reached its final depth. The section, shown in Fig. 1, is 13 ft. x 16 ft. 4 in. clear and required an excavated section 15 x 19 feet.

The entire shaft lies in what is locally known as Gila

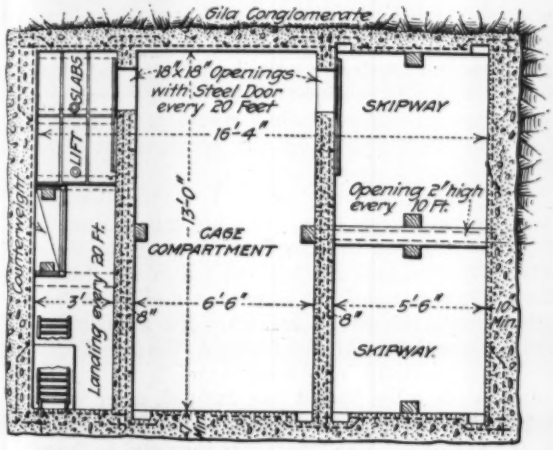


FIG. 1. CROSS-SECTION OF SHAFT, SHOWING CONCRETE LINING

conglomerate, a formation which is typical hardpan rather than a true conglomerate. Although the material is very hard, no blasting was done after water was encountered at a depth of about 200 ft., it being found practically impossible to remove the powder fumes from the fissures in the water-laden hardpan. Light jackhamers with "bull points" from 2 to 3 ft. long were used to break the ground. This method, besides permitting the walls to be trimmed neatly, with far less overbreak than would result from blasting, permitted a progress of 100 ft. per month.

The shaft was located on the side and near the top of a small, steep hill, the top of which was graded down by the contractor to the elevation of the collar of the shaft. The plant layout is shown in Fig. 2. The shaft being near the present operating plant of the Miami Copper Co., the air, water and electricity were delivered by that company at the collar of the shaft.

The contractor began erecting the headframe and other working structures Dec. 11, 1917, and hand excavated for the top 25 ft. of shaft without blasting, in order to avoid disturbing the ground adjacent to the collar. As the hoist could not be delivered until the end of January, 1918, the contractor obtained, late in December, permission to drift in from a tunnel of the Miami Copper Co. which passed within 20 ft. of the southerly corner of the shaft at a depth of 118 ft. This permitted the tramming of muck by hand a distance of about 300 ft. through the tunnel to a dump in the gulch at the tunnel entrance.

After the line of the shaft was reached, a raise was driven for the purpose of meeting the excavation from the surface. This raise was 2½ x 6 ft., of which 2½ x 2 ft. was a manway with ladders and the remaining space was occupied by a cribbed chute. At the tunnel level the drift was widened and the full shaft section excavated to make a working chamber large enough to accommodate a switch, which permitted the sidetracking of an empty car while another car was being loaded.

The full section of the shaft was then broken down through this chute by the use of 40% dynamite.

The drift was started Dec. 26, 1917, and completed Jan. 1, 1918; the raise was started Jan. 2, 1918, and completed at 6 a.m. Jan. 8, 1919—a rate of 5 ft. per eight-hour shift. The full section of shaft was excavated to the level of the tunnel Feb. 20, 1919, and 60 ft. of shaft had been concreted in the same period, as follows:

As soon as the excavation had reached a depth of 35 ft. the forms for the 25-ft. collar were started on 12 x

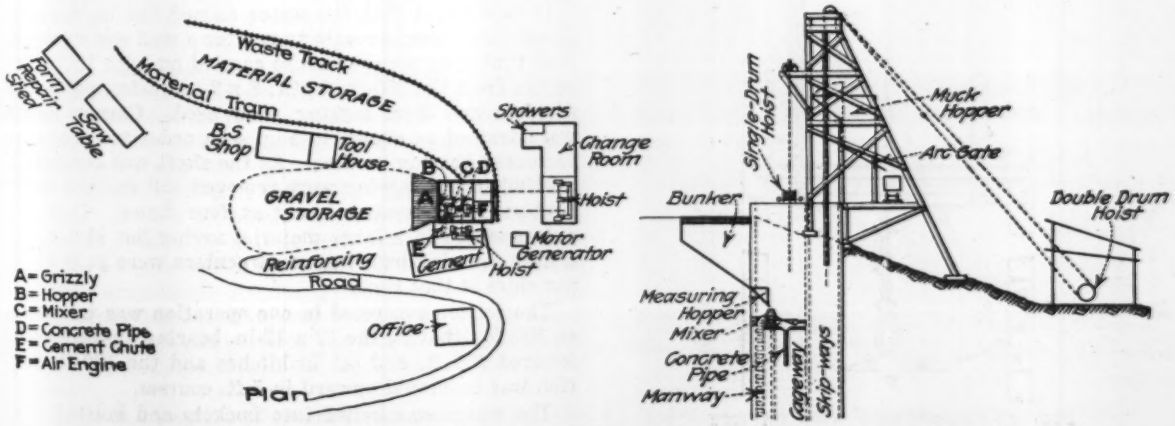


FIG. 20. PLAN OF CONSTRUCTION-PLANT LAYOUT FOR SINKING AND CONCRETING MINE SHAFT

12-in. bearing timbers placed in 18-in. hitches cut in the hardpan walls. No back forms were used, and the whole 25 ft. was poured continuously. As no water was encountered, no timbering was necessary.

While the collar was being concreted, the excavation had progressed to a depth of 55 ft. Hitches were again cut in the walls, and the three 12 x 12-in. bearing timbers were lowered into them. On these bearing timbers was placed a timber frame, the exact size of the concreted section, which served both as a bottom form and a sill on which the form panels could be set. The vertical reinforcing rods were then hooked to the verticals which had been left projecting from the bottom of the previous concrete, and the horizontal reinforcing was wired to the verticals. A 5-ft. section of forms was then placed and concrete was poured, this process continuing until the concrete was carried up to the bottom of the collar section. It was found that the ground would safely permit the opening up of a depth of fully 25 ft. of shaft without lateral support, and the concrete was carried down in 20-ft. sections by the above process for the first 200 ft. of the shaft.

As soon as the raise from the tunnel level was finished and the breaking-down process was well under way, a small air hoist was installed at the tunnel level, and the two skip compartments were sunk and timbered as a pilot shaft, this muck being hoisted to the tunnel level and also trammed through the tunnel. Thus excavation was being carried on simultaneously at two levels

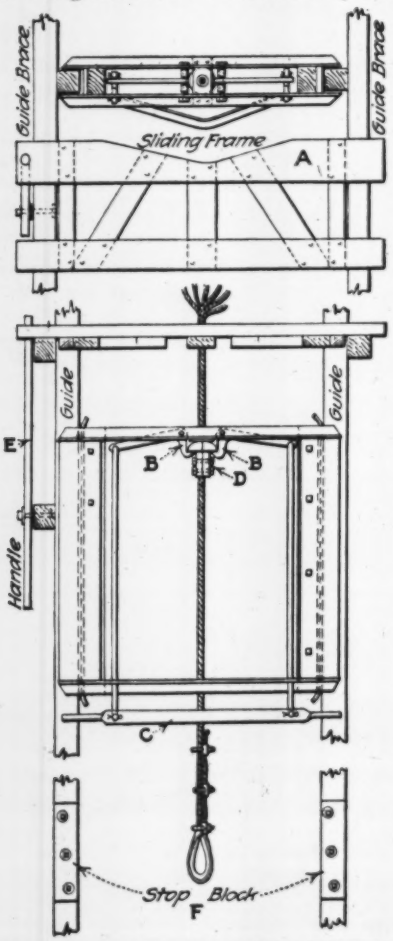


FIG. 3. CROSS-HEAD AND SAFETY DEVICES

without interference, while waiting for the double hoist to be delivered.

By the time the whole shaft had been excavated down to the tunnel level a two-compartment pilot shaft 100 ft. deep was ready, one compartment serving as a chute through which to draw off the muck from breaking down the full section of the shaft and the other a hoisting compartment to the tunnel level through which the muck was still trammed.

Water was encountered at this depth (218 ft. below the surface) and while the full shaft section was being excavated to this depth the double-drum hoist was delivered and installed and a special crosshead was devised to comply with the requirements of the Arizona mining laws and at the same time permit the bucket to be dumped into the receiving bin in the headframe without excessively increasing the height of the latter.

As it was neither possible nor desirable to keep the bucket guides extended nearer the bottom than 15 to 30 ft. while sinking was in progress, this crosshead had to be such that it could be stopped at any desired point in the shaft as well as at the headframe and allow the bucket or skip to continue on, for filling or changing at the bottom or dumping when reaching the headframe. This was accomplished by the arrangement shown in Fig. 3.

A lug D was securely clamped to the cable about 6 ft. above the shackle loop. This lug engaged the dogs B and thus attached the crosshead securely to the cable. When the crosshead reached the top of the headframe, the top lander pulled the lever E and slid the frame A over against the guides and gave the lowering signal. The bumper C then hit the frame A, the dogs B released the lug D and the crosshead was left resting on the frame A while the bucket was dumped, after which the latter was raised high enough to take the crosshead off the frame A. The frame was then slid back and the bucket with the crosshead attached was ready for lowering. At the bottom of the shaft, or at any other point where free use of the bucket was desired, stop blocks E were bolted to the guides and performed the same function as the frame A at the headframe. This crosshead gave perfect satisfaction.

From the 218-ft. depth to the bottom the full section of shaft was excavated by the use of bull points; three men using jackhamers working them into the material loosened all that four muckers could load into the buckets.

It was found that the water caused the hardpan to slough very treacherously soon after a wall was exposed. Full timbering was therefore carried on with the excavation from the 250-ft. depth; 8 x 8-in. plates, posts and dividers and 2-in. lagging were used. Corner joints were framed as shown in Fig. 4 in order to secure an increased bearing surface. As the shaft was concreted, all timber and lagging were removed and re-used, some timbers being used as many as four times. This not only resulted in a large material saving but also saved a high framing expense, as carpenters were paid $7.25 per shift at that time.

The section concreted in one operation was increased to 100 ft.; that is, the 12 x 12-in. bearing timbers were lowered 100 ft. and set in hitches and the 100-ft. section was concreted upward in 5-ft. courses.

The water was bailed into buckets and hoisted, five buckets per hour, or 600 gal. which, together with the

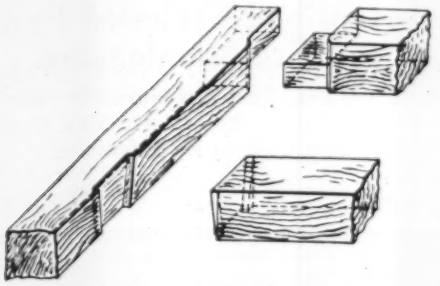


FIG. 4. DETAIL OF TIMBER FRAMING

water shoveled and hoisted with the muck, was sufficient to keep the bottom free. A timber bulkhead 6 in. thick was kept not over 50 ft. above the men working in the bottom over all of the shaft except the two skip compartments. While the reinforcing and forms were being set in one of the skip compartments all the hoisting from the bottom was done in the other compartments, and after the forms were set one of the skip compartments was bulkheaded at the level of the top of the forms, as were the cage and manway compartments, one skipway only being left open for hoisting.

Upon the completion by the contractor of the contract for lining with concrete the old shaft No. 3 of the Miami Copper Co., a mile distant from the new shaft No. 5, about Apr. 1, 1918, the single-drum hoist from shaft No. 3 was installed at shaft No. 5, as shown in Fig. 2, working from extension timbers from the same headframe and operating in the cage compartment.

This hoist handled all reinforcing, forms, concrete pipes and timbers to the form and concrete gangs, and as there was always a bulkhead in this compartment over the men in the bottom, the danger of working at two different levels was greatly lessened. This hoist was also used in pulling and resetting the rather heavy wooden forms in all compartments. It proved nearly as fast as a derrick and obviated the use of the slow and expensive block-and-tackle method.

Separate bunkers for sand and gravel were excavated immediately adjacent to the collar of the shaft at the manway end, and the sand and rock from the crushing plant, which was installed in the creek bed, was dumped through grizzlies into these hoppers. Through openings left in the shaft collar, with arc gates, the sand and stone passed into measuring hoppers inside the manway and cage compartments. These hoppers were of the proper dimension for a one-bag batch, and from these hoppers the material was chuted to a batch mixer located in the shaft cageway compartment 20 ft. below the surface. The cement was slid in bags down a chute from the door of the cement shed through an opening in the south side of the cageway compartment directly to the mixing plant.

The mixer, of 8-cu.ft. capacity, was belt-driven from a small air hoist set at the same level. This plant occupied the southerly half of the cage compartment and manway compartment, the wall between the two being omitted temporarily for its accommodation, the whole plant occupying an area only 7 ft. x 9½ ft., as clearance for buckets and material handled by the small hoist in the cage compartment had to be maintained at all times.

The 1:2:4 mixture of concrete was dumped from the mixer through a 6-in. iron pipe with screwed couplings and with the fall broken at junction boxes every 300 ft. and at the swiveled chute which carried the concrete to the forms around the shaft. This pipe was supported by timber clamps resting on 6 x 8-in. timbers carried in recesses left in the concrete when poured, and on the shaft timbers where the concrete had not yet been placed.

In the manway compartment the permanent iron ladders were placed in position as the concrete lining was placed. In advance of that, the permanent ladders were placed on temporary wooden landings. Concrete-lined stations were located at 235, 490, 576, 643, 729, 770, 835 and 920 ft. below the surface. The 490- and 576-, also the 770- and 835-ft. stations were the top and bottom of future ore pockets. The ore pocket between the 643- and 729-ft. stations is now being constructed.

To facilitate the construction of these pockets, 4 x 4-ft. cribbed chutes were excavated before the shaft was concreted just outside of the concrete walls of the northwestern skipway, with a gate and a chute leading into the skipway at the bottom of each pocketway. When the ore pockets are constructed the muck will be shoveled into these chutes and drawn off at the bottom and the cribbing removed as the excavation proceeds, thus effecting a considerable economy in the cost of excavation.

For the hoisting in the cageway compartment, cable guides were installed, carried on reels on the headframe and unreeled as the shaft was deepened, and even at the full depth of 936 ft. these did not oscillate enough to cause any difficulty.

To avoid trouble with the permanent guides from the use of expansion bolt fastenings, and to avoid the irregular spacing of bolt holes in the guides if anchor bolts were set in the concrete as it was poured, a novel guide fastener was designed. It was built in the concrete as poured, but still allowed drilling of the bolt holes by templet after the shaft was completed and allowed a leeway for any reasonable irregularity in location while pouring. These fasteners are shown in Fig. 5.

A chart was kept showing the progress made each day by each shift on each part of the work. A large-scale elevation of the whole shaft, stations, tunnels and ore pockets was made, and a certain portion was allotted to excavation, timbering, form work, reinforcing, concreting, etc. To each shift boss was asigned a certain color, and the portion of the chart representing the location and the amount of work done was colored for the shift doing the work. The date was then written through the color. Quantities for this purpose were determined both by actual measurement and by the foremen's reports. For instance, the number of buckets of

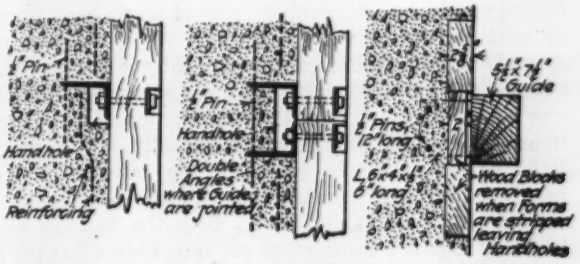


FIG. 5. DETAIL OF NOVEL GUIDE FASTENING

muck hoisted was a close check on the advance in sinking for that shift. The foremen were never formally notified that this chart was being kept, but within two days from the time it was instituted they all seemed familiar with it and watched it closely.

This chart not only furnished information as to progress at all times and gave a comparison of the work accomplished by each shift, but it also served as a record which showed at a glance which shift boss had excavated any part of the work. If faulty workmanship had been discovered it would have been simple to trace it.

Probably the greatest value of the chart, however, lay in the competition it aroused among the shift bosses, who realized that their work was being closely followed and that they were getting due credit.

In spite of the fact that the hardpan through which the shaft was driven is so firm that all former shaft sinking in the district had been done by blasting, it sloughed badly upon exposure to the air, and this without warning. Ground which had been sounded and found solid but a few minutes before would suddenly fall with no warning, so that the sinking combined the difficulties of both hard-rock work and soft, treacherous ground. In spite of this fact, there have been no serious accidents to either construction or the employees during the entire work, which means that while every precaution has been taken to safeguard the men and the work, good luck has also favored the job.

The Foundation Co., of New York City, did this work by contract, under the supervision of its Pacific Coast department, with Bayly Hipkins, vice-president and Pacific Coast manager and A. S. Lilley assistant manager; and under the direct charge of the writer as superintendent, James H. LeFeaver as assistant superintendent and John Sheehy as night superintendent.

Suggests Light Railway Feeder Lines

Light railways of the type used between the main-line railways and trenches during the world war were suggested as having a definite transportation value in sparsely settled countries, in a paper by Charles F. Lang, president of the Lakewood Engineering Co., read before the Pan-American Commercial Congress in Washington. Mr. Lang called attention to the developments in detail design and construction which were brought about by the war use of the narrow-gage railway, with its readily portable track and tie system. He suggested the use of such a railway to supplement the highway and the standard-gage railroad. He said there were a number of places where both the highway and the main-line railway were too expensive to build, particularly in undeveloped stretches of territory. The light railway could be laid out on fairly steep grades with high curvature through undeveloped country with a minimum of earthwork, and there could be in every farm or mine area a personally owned track, each tying up with the through line. He also suggested that in sparsely settled territories which might not warrant the expense for a first-class highway the narrow-gage railway could be used (1) for the construction of a cheaper improved highway which would be sufficient to carry light passenger traffic, and (2) the railway having been used for such construction, it could be used as a railway for the heavier traffic, both the railway and highway together costing less per mile than a hard-surface road would cost now in the United States or Canada.

Important and Neglected Features of Tire Maintenance

Tire Cost and Fuel Cost Are Normally About Equal For Large Trucks—Abuse May Cause Tire Cost to Be Excessive

By A. F. Masury
Chief Engineer, International Motor Company, New York City

LARGE numbers of persons who use motor trucks—such as contractors—consider that economy, as far as the trucks are concerned, means gasoline saving. However, saving of tire cost is equally important. On a heavy truck the tire cost and fuel cost are about equal. On lighter vehicles tire cost is slightly less than fuel cost, unless pneumatic tires are used, when the tire cost will slightly exceed fuel cost. Why, then, should we hear so much about means of saving gasoline and so little about economizing on tires? While the two items of cost are normally of equal magnitude, abuse of tires can raise their cost out of all proportion to their normal cost, and can swell this item far beyond the utmost extravagance in fuel.

It is a fortunate circumstance that gasoline waste inevitably limits the ability of the vehicle to perform, and that unless the carburetor adjustment is set for reasonable economy the truck will hardly operate at all and consequently cannot consume an excessive amount of gasoline. On the contrary, tire abuse, unfortunately, limits the performance of the vehicle but little, and in addition gives rise to increased chassis maintenance and even increased fuel cost.

Truck owners are often encountered who are extremely particular about carburetor adjustment, who employ the latest air-warming devices, and insist that the engine be shut off at each stop, but they allow the tires to remain cut and slivered, the wheels out of line, and the truck running daily on the car tracks. The truck will actually consume less gasoline without a governor than with one, but the removal of the governor and the consequent overspeeding imposes a heavy toll on tires.

Commonest among tire abuses are overloading, overspeeding, running in car tracks, neglecting cuts and tears, spinning, skidding and sliding the wheels, and wheel misalignment.

Overloading—This stresses the tires beyond their elastic limit, utterly destroying the life of the rubber, and, therefore, the durability and cushioning ability of the tires. Fig. 1 shows a tire which has been over-

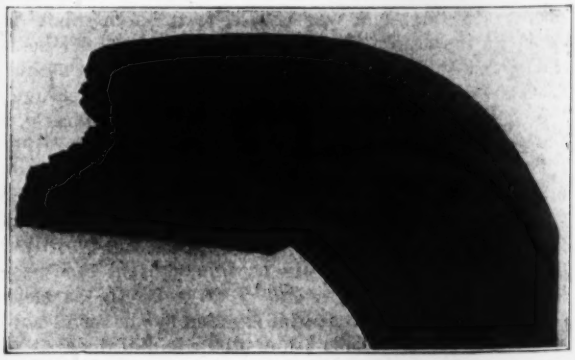
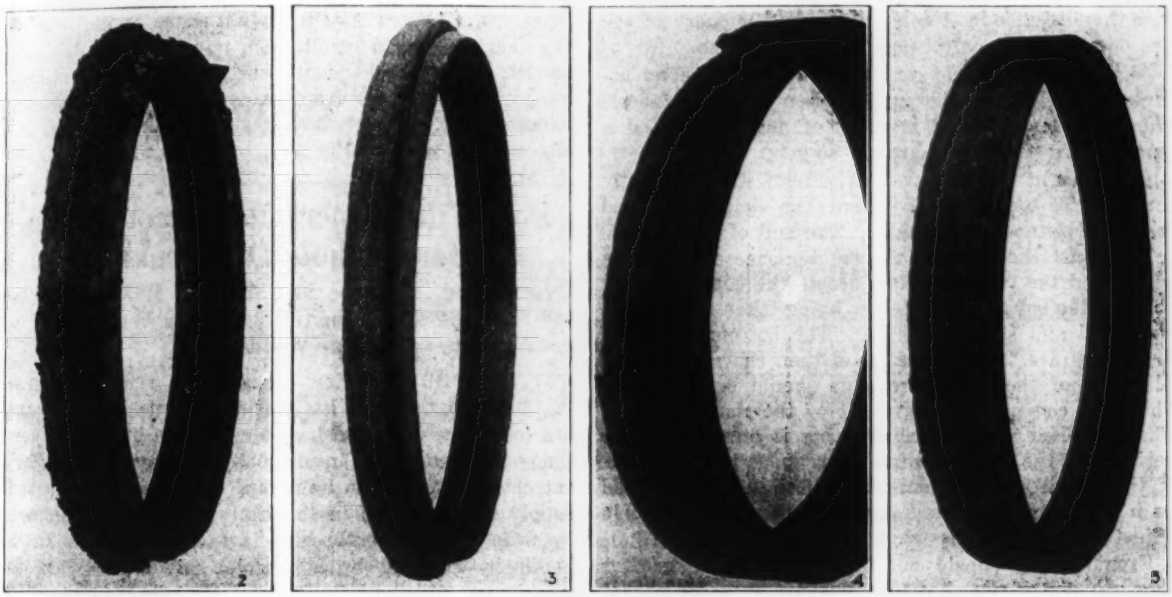


FIG. 1. OVERLOADING DESTROYS THE LIFE OF THE RUBBER AND CRACKS THE TIRE

loaded. Note the peripheral crack near the base and the separation of the tire at the base.

Overspeeding—Even with a light load, overspeeding has the same effect as overloading, since the increased speed causes the impact of the tire on road bumps to be magnified. Running over a bump at twice the normal speed pounds the tire eight times as hard, and consequently may overload it at one spot 400%. A tire treated in this manner may be seen in Fig. 2. If high speed is necessary, pneumatic tires should be used, though they cost more; it will be much cheaper than



FIGS. 2 TO 5. CONDITIONS RESULTING FROM VARIOUS ABUSES OF SOLID RUBBER MOTOR-TRUCK TIRES
Fig. 2. Overspeeding. Fig. 3. Running in car tracks. Fig. 4. Neglecting slivers, skidding and sliding.
Fig. 5. Misalignment of wheels.

putting solid tires in the condition shown, after a few hundred miles.

Running in Car Tracks—This simply cuts the tires by centering the pressure at one point instead of evenly over the treads. A tire which has been run in car tracks is shown in Fig. 3. The edges of the rails, particularly the guard flanges of street-car tracks, become sharpened by the friction of the car wheels. Running tires over them is much like running them over the edges of steel knives.

When solid tires are cut or torn by glass or sharp stones the rubber slivers. These slivers should be cut off as soon as they appear. Care should be taken that a clean notch just below the end of the tear is made. If the sliver is left on, it will contribute nothing to the strength of the tire but will continue to extend until half the tread width is torn loose. Fig. 4 shows the condition produced in a tire by allowing slivers to remain uncut.

Spinning, Sliding and Skidding—Spinning and sliding the tires in starting and stopping, and skidding in rounding curves, also leaves serious destructive effects similar to that shown in Fig. 4. Upon loss of traction most drivers will speed up their engines under the wrong impression that this will increase traction. Actually, it does the reverse. The more slowly a wheel turns the better traction it has, the more gently it is started turning, the less liable it is to slip. When a wheel begins to lose traction the driver should throttle the engine rather than speed it up, retarding his spark and being ready to release the clutch to prevent stalling. In engaging the clutch it is also well to let it in gently, and low gear should be used, as this will permit the wheels to turn very slowly without so much danger of stalling.

In the application of the brakes the wheels should not slide. Not only does sliding the wheels injure tires, but it reduces the braking effect. The quickest stop is made when the wheels are just turning and the abrasion of the tires is least. Skidding on rounding curves is as unnecessary as it is dangerous. It is due to turning at excessive speed. All of these abuses do untold harm to the tires. A tire is made to roll over the ground, not to slide.

Besides these more obvious causes of excessive tire wear, there is an insidious cause which is too apt to be overlooked. This is faulty alignment. When the tire rolls smoothly there is a minimum of wear, but if out of alignment, it has a combination rolling and sliding movement over the road which not only causes rapid wear but consumes power. There are two forms of faulty alignment; that in which the wheel itself is out of line, so that it wobbles, and that in which the wheel spindle is at an improper angle, so that the wheel is constrained to a position out of parallel with the direction of the vehicle's motion.

Wheel wobbling is caused by warping of the wood and strains. Some of the strains which get wheels out of true can be avoided. When a truck is driven diagonally into the curb, for instance, or when a corner is rounded too sharply or a boulder is struck a glancing blow, the severe lateral strain at one point of the circumference of the wheel is apt to warp it. Sometimes carelessness in applying or removing pressed-on tires warps the wheel, and in some cases a careless operator

will press the tire on crooked, so that the effect on the tire is the same as that of a warped wheel. The remedy is to have the tire pressed off and the wheel trued.

Misalignment of the wheel spindles is due to excessive shocks, such as running into curbs, overspeeding on rough roads, and so on, which bend the axle or the steering arms of the front steering knuckles. The destructive effect of a slight misalignment can readily be appreciated when one realizes that if a wheel is only out of line one degree horizontally it must slip 92½ ft. sidewise in a mile of travel. The destructive effect upon the tire is the same as though the truck were pulled sidewise this distance by a winch. On the periphery of the tire one degree is only equal to about $\frac{9}{32}$ inch.

Alignment of wheels can only be made true by accurately checking the distance between the wheel felloes. There are several good methods of doing this, and a number of methods that are not so good.

Most motor trucks have their rear wheels exactly parallel. To test their alignment, the simplest method requires two men and a tape. The end of the tape is held against the front of the inside space on one rear wheel, and the tape stretched across the corresponding point on the opposite wheel, care being taken to have the tape level and stretched tight. The bottom points of the felloes are then checked, and then the rear points. All three of these measurements should be the same. The most common misalignment of the rear wheels is what is called a spraddle. By this is meant that the bottoms of the wheels are farther apart than the top. If this condition is found, the wheel bearings should be inspected for looseness first. If these are properly adjusted, then the axles should be straightened.

Front wheels should not be parallel. For greater strength and easier steering they are cambered; that is, the wheels are farther apart at their tops than at their bottoms. To correct the resulting tendency for them to roll incorrectly they are correspondingly gathered so that their fronts are drawn or toed-in, usually about ⅜ in. Measuring as before, correctly aligned wheels will have their bottoms and their fronts about the same distance apart; the bottoms may be ⅛ in. closer together than the fronts, but should not be farther apart than the fronts.

If these measurements do not check, the gather at the front may be adjusted by means of the tie-rod, which is threaded for adjustment. Before adjusting the tie-rod, however, it would be well to be sure that the steering arms have not been bent. This can be determined by measuring the distance from the ball or pin, as the case may be, to the wheel felloes. The two arms should be the same distance from their respective wheels. If they are unequal, the one that is bent should be straightened, until the distance is the same, and the final adjustment made on the tie-rod.

So far, these checks apply only to the relation of the wheels to each other. Another important check must be made on the alignment of the axles with the frame. Naturally, the axles should be perpendicular to the chassis center line. This can best be checked by selecting a fixed point at the center of the axle, such as the front universal, and checking the measurements from it to the nearest unobstructed point on each rear wheel. The two should be equal. If unequal, be sure that the truck is on level ground and that the two rear springs are deflected equally. This may be checked by measuring the distance from the bottom of each frame side rail to the axle. If unequal, a jack may be used to raise the low side of the axle to the same level as the other side. The measurement to the universal can then be repeated. If it is found to be still unequal, the cause will be found either in unequal radius-rod adjustment, or, if no radius rods are fitted, in loose axle spring-clips which have permitted the springs to shift. At the front a similar check may be made from some central point on the crank case to the opposite point on the wheels.

Too many motor truck users neglect to check their wheel alignment until the occurrence of an accident or other cause that necessitates a serious repair. Misalignment is apt to result from minor causes in daily service, and unless frequently checked may go unnoticed, bringing about excessive tire destruction without apparent cause. A tire which has been damaged by misalignment is seen in Fig. 5.

Poor Filter Operation Accountable for Typhoid Outbreaks

Overworked Filters in Moline, Ill., Lead to Bypassing Nonsterilized Raw Water to Clear-Water Basin

UNFILTERED water bypassed to a filtered-water basin in Moline, Ill., during the past two years has cost many lives and has caused not a little sickness. Clogged underdrains, insufficient capacity and indifferent chlorination of an unfiltered or improperly filtered supply are the links in the chain of typhoid carriage by which typhoid outbreaks have occurred in a town nominally supplied by a potable, safe water, despite newspaper boil-the-water advertisements to the contrary. Two exhaustive reports on the situation have been made by the Illinois State Board of Health. The first, dated February, 1918, went thoroughly into the series of outbreaks which occurred in the autumn and winter of 1917 and indicated that there were many interruptions in the chlorination of an inefficiently filtered and unsafe water. Typhoid in cities discharging into the river from three to 35 miles above the intake was held largely responsible for the infection of the raw river water. The second report took up a later outbreak traced to the opening of a bypass valve in June, 1918.

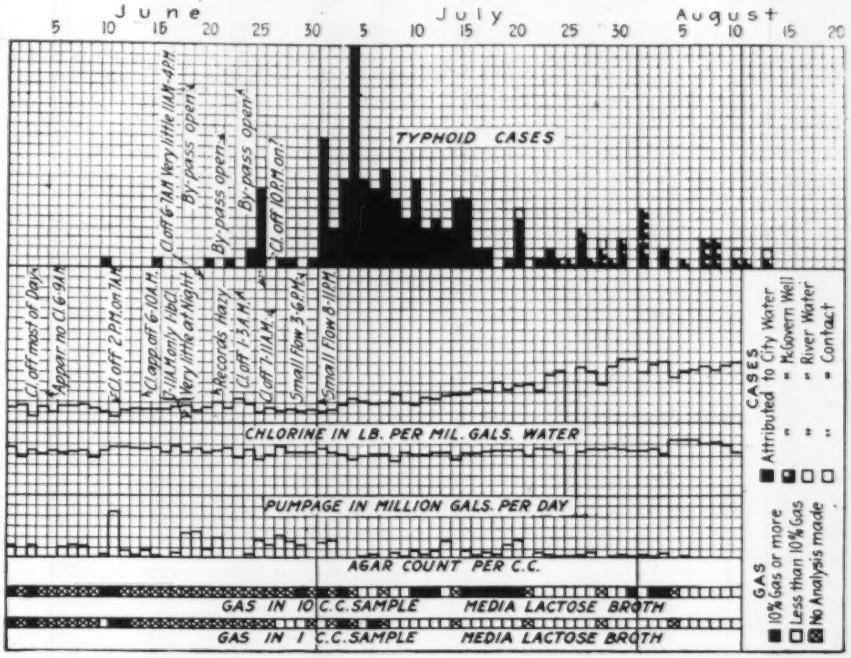
In 1902, Moline installed a mechanical filtration plant providing space for five 1,000,000-gal. units, but only three were equipped until 1910. An original 30-in. bed of sand overlying 14 in. of gravel was reduced to 20 in. in 1918. A large portion of the underdrainage system had become clogged, and only portions of the bed could be washed; thus the rate through the washed portions was increased excessively. Bacterial efficiencies of the plant ranged from 35 to 96 per cent., averaging 70 per cent. Due also to the clogging, the quantity filtered was insufficient, and water on the surface of the filters was bypassed directly to the filtered-water basin. This was made possible by the insertion of a valve below the junction of the wash-water outlet and effluent-to-drain outlet as shown in the sketch. The report states:

> Judging from the rather frequent use of the bypass, it appears certain that altogether too much confidence has been placed in the chlorinator, and far too little attention has been given to the filters.

Mechanical devices will sooner or later give some trouble, and the chlorinator installed at Moline was no exception, for it has balked on a number of occasions. It is only to be expected, therefore, that with the filters operating with very low efficiencies, with the water bypassed at times and the chlorine off at spells, that the water-supply must have been of a quantity at times which would menace the health of the consumers.

However, the defects of the filter plant and chlorine machine, and the dangers due to using the by-pass appear to have been reported by the operator to the city authorities at different times during the winter of 1917-18, while the public was warned by newspaper advertisements from Feb. 15 to July 2 that the water was unsafe.

In July, 1918, the State Board of Health was called in again to investigate further outbreaks. Although the filter plant had been partially overhauled following the winter outbreak the investigation practically eliminated, as before, all sources of infection but the water.


June
July
August
TYPHOID CASES
Cl. off most of day
Appar. no Cl. 6-9 A.M.
Cl. off 2 P.M. on 7 A.M.
Cl. appr. off 6-10 A.M.
Cl. off 6-7 A.M. Very little 11 A.M.-4 P.M.
By-pass open
By-pass open
Cl. off 10 P.M. on
Records Hazy
Cl. off 1-3 A.M.
Cl. off 7-11 A.M.
Small Flow 3-6 P.M.
Small Flow 8-11 P.M.
CHLORINE IN LB. PER MIL. GALS. WATER
PUMPAGE IN MILLION GALS. PER DAY
AGAR COUNT PER C.C.
GAS IN 10 C.C. SAMPLE MEDIA LACTOSE BROTH
GAS IN 1 C.C. SAMPLE MEDIA LACTOSE BROTH
CASES
Attributed to City Water
" " Kilbourn Well
" " River Water
" " Contact
GAS
10% Gas or more
Less than 10% Gas
No Analysis made

CONDEMNATORY RECORDS PREVIOUS TO EXPLOSIVE TYPHOID OUTBREAKS

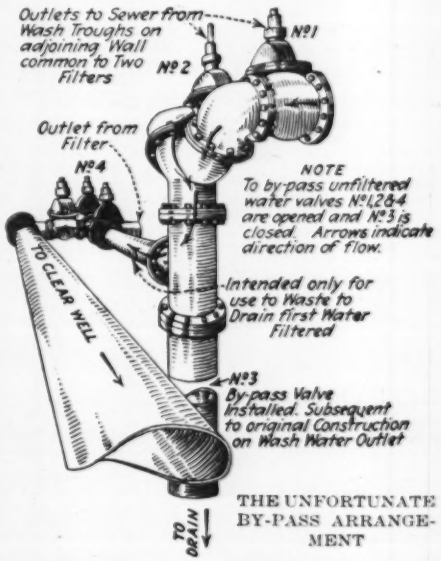
Quoting again from the report:

> It appeared quite impossible, therefore, that so large and explosive an outbreak (see chart) could result from water which had passed through the filters, even should the chlorine used for disinfection have been turned off for some reason. It appeared so evident, however, from the investigation that the water was the source of infection that it was only natural to suspect that the bypass had been opened at some time or other. . . . The raw water during a portion of this time had been passed through but one of the settling basins, as the other basin was being washed during the night. Even the settled water entering the filters and the bypass was, therefore, of inferior quality.
>
> It was found that both on June 19 and again on June 22, during the periods the bypass was open, no chlorine was being added for considerable periods, and very small quantities the remainder of the time, due to trouble in the chlorinating apparatus.

Following the main outbreak, reports of an unwarranted number of cases continued. A study made of this situation showed that a well extending almost wholly in limestone located at 352 Eighth St. had become infected through the entrance of sewage from near-by sewers and a number of people received their infections here.

The board declares unqualifiedly that the bypass is a dangerous arrangement which should be removed at the earliest possible date. For the time being, until additional filters are installed or additional storage capacity for filtered water is afforded, the bypass might be retained, but should be fastened shut by means of a lock and chain and the key left with one of the head men at the plant. This bypass should then be opened only in the event of an emergency, and only with a very heavy and continuous flow of chlorine being applied to the water. The bypass has already caused Moline citizens sufficient trouble, and it should not be permitted under any circumstances to repeat the past performance.

Connections between manufacturers' and city mains were under suspicion, and tests indicated that the single check valves tested were not always effective, but the general spread of the outbreak over the whole town practically eliminated the dual system. The practice was condemned, however, by the board. The investigation was made under the direct supervision of M. C. Sjoblom, then acting chief engineer for the Illinois State Board of Health.


Outlets to Sewer from Wash Troughs on adjoining Wall common to Two Filters
No 1
No 2
Outlet from Filter
No 4
NOTE
To by-pass unfiltered water valves No 1, 2 & 4 are opened and No 3 is closed. Arrows indicate direction of flow.
TO CLEAR WELL
Intended only for use to Waste to Drain first Water Filtered
No 3
By-pass Valve Installed Subsequent to original Construction on Wash Water Outlet
TO DRAIN

THE UNFORTUNATE BY-PASS ARRANGEMENT

The Long Beach Sewage Screen; A Correction

In the article on the sewage screen at Long Beach, Calif., published in *Engineering News-Record* of May 22, 1919, p. 1012, the names W. J. Knowlton and J. W. Geeks should have read W. T. Knowlton and J. W. Cooke. On p. 1013, in the same article, the dates Jan. 3 and 4, 1918, should have been June 3 and 4.

Bettering Concrete by a New Mixing Method

Using as a Basis Motion Mixture Studies of Concrete in the Mixing, New Type of Mixer Is Developed In Which, It Is Claimed, Cement Gets Necessary Thorough Contact With Aggregate

BY NATHAN C. JOHNSON
Consulting Engineer, New York City

This is a part of a lecture entitled "Better Concrete; the Problem and Its Solution," delivered recently by Mr. Johnson before the Philadelphia Engineers' Club. The lecture was much longer and contained a number of motion pictures of concrete during the mixing and setting processes. These pictures were taken with a special camera with an automatic long-interval shutter, so that the views reproduce on the screen, in a few moments, natural processes taking many hours or days—EDITOR.

SINCE the majority of the units entering into concrete are minute, they may be virtually affected in whole or in part by things minute, although collectively of great importance. It may even prove on examination that what to the eye are tiny crazings, of questionable import, may be vast chasms relative to the size of a cement grain put into the mass as a medium for transferring stress from sand grain to sand grain and that they may interpose impossible barriers to its functioning. Single air voids not uncommonly bulk larger than a dozen or more sand particles; and air voids are known to be present in vast numbers. Water pockets by the thousands in a single yard of concrete may cut off certain other would-be workers by the hundreds of thousands, and even sizable stones.

To estimate the true significance of such possibilities it may be well to place in diagrammatic form, as a preface to deeper study, the family tree of concrete. (See Fig. 1.) First and foremost in importance is the "glue" formed by the union of the powdered cement of

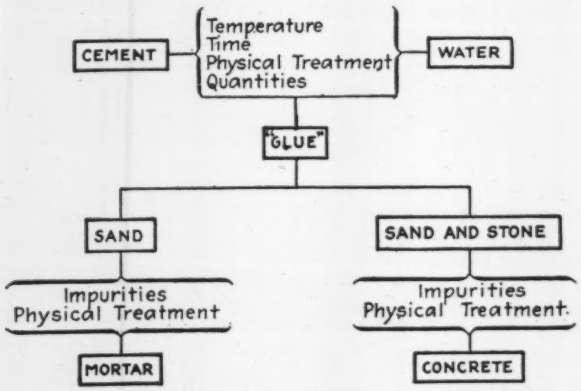


FIG. 1. GENEALOGICAL CHART OF CONCRETE AND MORTAR

commerce with water. As this formation is a chemical reaction, it follows the laws of such reactions and is affected vitally by two variables, temperature and time. The first is particularly difficult of regulation in field operations, but the second—as well as a third variable, physical treatment—may be controlled. Obviously, also, the strength of the fluid cementing solution so produced will depend primarily upon relative quantities of the two reacting substances. To the "glue" thus formed, which has greater or less worth according to the values of the variables affecting its formation, sand is added to make mortar, or sand and stone to make concrete—with, in each case, impurities, such as air, or other contaminating substances, and, again, physical treatment, entering as factors qualifying ultimate value.

If cement were supplied as ground after burning in kilns, it would be so hungry for water that reaction with mixing water would take place too quickly; and to avoid this, manufacturers add gypsum, which is hydrous or water-bearing calcium sulphate, to the still hot cement. This heat drives off water from the gypsum; and this water, spreading as steam, reacts with the hungry cement particles, forming over their surface a very thin, protecting skin of dead or hydrated cement, which for a time—depending upon the thickness of this skin and the temperature—resists penetration of mixing water to the active material within, deferring reaction to give ease in handling. It follows, therefore, that little of this chemical action has taken place before concrete is placed in forms.

Such a protective skin is pictured in the photomicrograph, Fig. 2, about an inert cement grain found in concrete. Obviously, it should be advantageous to remove this dead skin in some way when ready to use cement, so that water might find access without delay and make more and stronger "glue" in the brief hour or two of freedom before setting takes place. Of course, we must coat sand and stone with cement. Yet reason tells us that even an infinite supply of cement particles can cover a sand particle only so far as they may touch it at tangent points, while a solid bedment is assumed and desired in concrete. If there is not an infinite supply of cement particles, even this tangent covering is not possible.

Furthermore, when cement particles, sand particles and pieces of stone are wet, an envelope of water covers them, preventing contact, except accidentally, even at points of tangency, as shown in the diagram, Fig. 3, traced from the photograph, Fig. 2. This explains why there is rarely, if ever, contact between particles as their relative positions are revealed in magnified photographs.

A little thought and calculation with regard to aggregates reveal certain other facts not often considered. Briefly, these are that in a cubic yard of 1:2:4 concrete there are about one million stone particles, up to and including 1½; that there are about 25 *billion* sand particles with a commercial coarse sand, or 200 billion particles with a very fine sand, all of which have to be distributed and wetted and mixed with some 200 to 300 billion cement particles in a space of time that will pay commercially—usually less than a minute. Evidently, since this is so, "covering" sand and stone with powdered cement would really mean that when using coarse sands there would be not to exceed four to six cement particles; and using fine sands, not to exceed 1 to 1½ cement particles for each piece, large or small. Covering should be actual and thorough and uniform, but, obviously, true covering can only come through spreading of a liquid cementing product; and to achieve even

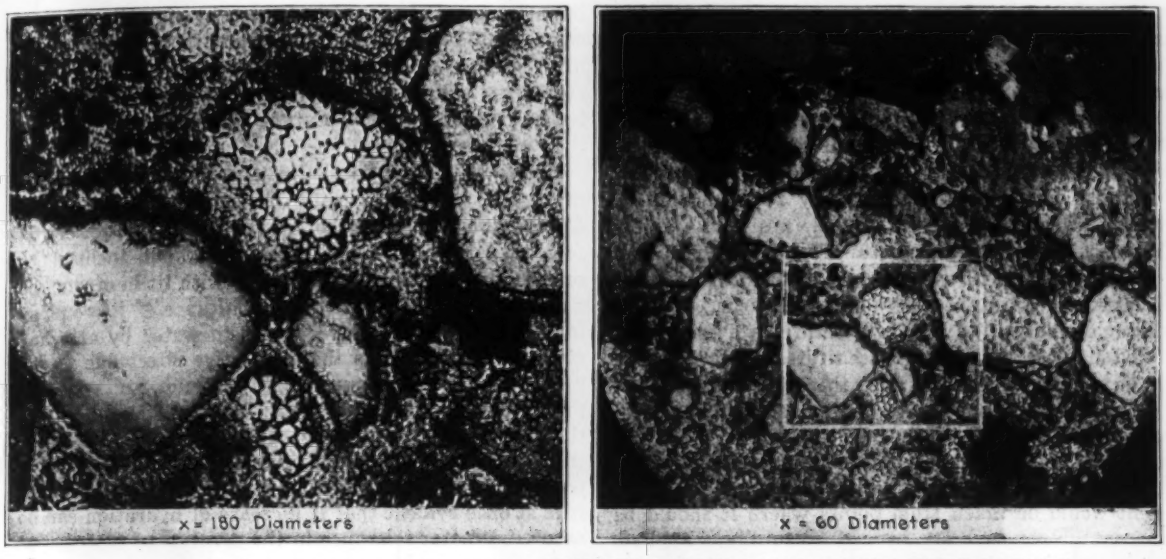


FIG. 2. PHOTOMICROGRAPHS OF COMMERCIAL CONCRETE SHOWING SAND GRAINS, UNUSED CEMENT AND AIR VOIDS

The view at left is an enlargement of the section limited by lines on the right view

a fair result, there must be left no analogue to the "unstirred sugar" of a cup of coffee, else some billions of potential workers will be rendered idle through denial of means wherewith to do their appointed share of work.

Remembering these things, further light may be gained by reconstructing the processes that formed a representative concrete, now in existence. Concrete from the warehouse of the Naumkeag Steam Cotton Co.'s warehouse at Lynn, Mass., is shown in Fig. 2, magnified 60 diameters. In it are clearly visible the sectioned sand grains with their irregular outlines; the clear matrix of hydrated cement; a few voids; and some "unstirred sugar" in the form of unhydrated cement particles. In Fig. 2 is also shown the lower center of the same field, enlarged to 180 diameters. It is to be remembered that in each of these photographs the relative positions held by the several substances are the positions held by them when placed in forms and that must be held by them so long as the concrete endues. What happened when this relationship was first established? All cement particles in the vicinity doubtless reacted with water, rather quickly for some time after the protecting skin was pierced. During this interval the sand grains lay surrounded by water, waiting quietly whatever might happen, save, perhaps, for an occasional settlement to easier position as concrete deposited above increased the general pressure.

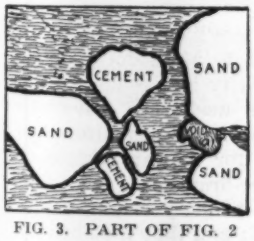


FIG. 3. PART OF FIG. 2

Showing relation held by cement and sand particles and water when placed in forms

At the surface of cement particles, however, there was, at first, saturation of the hydrated skin; then spasmodic reactions as water first reached active cement, formed new products, became sated and gradually diffused; then renewed activity as new water reached deeper layers of active cement through the same agencies, with repetition of the processes until setting of the richest products *directly at the surfaces of the cement particles* formed a new protective skin and brought about a shut-down of hydration.

The water-filled space about cement and sand particles was, during this time, gradually becoming charged by diffusion with these cementing products. But, diffusion is slow; and as distance from the source increased, concentration of these products became less, being *least* at the surface of the sand particles, where for man's purposes, it should have been *greatest*. If diffusion could have been aided by stirring, this defect would have been overcome; and, furthermore, longer activity of the cement particle would have been possible through removal of those surcharged products at its surface (where richness was not desired) and supplying of fresh water. Surely, one way of improving concrete should lie in procuring by some means a greater concentration of cementing products and distributing these, instead of insulating and diluting water, over the sand and stone *before* they find their final position in forms. If this were done, "water voids"—spaces left by water uncharged with cementing products—would disappear, for there would then be no uncharged water and the nature of such charging products is to solidify.

One other feature is prominent in these photographs; namely, an air void (recognized by its spherical or spheroidal form) tucked away at a surface pocket in a sand grain. When this grain was first wetted, this pocket was, of course, filled with air; and before the air could escape the viscous water envelope went over it, imprisoning it by surface tension; and, as diffusion progressed, molding it for all time in solidified cement.

By optical examination, boulders and sand grains of all sizes are found to have similar surfaces, full of pits and seams which are admirable for attachment of cement if contact could be brought about, but potent for ill unless inclusion of air bells is prevented. If only some means, such as stirring or scrubbing, could be utilized to remove impurities such as air, considerable improvement in general quality should result, for although one void is very minute, its duplication billions of times must be of great importance.

Although the mind sees in increasing number other possibilities indicated by reasoning as probable means of bettering concrete, those cited have every element necessary for very substantial improvement, provided they can be put into effect.

Starting experimentally with studies of the chemical union of cement and water, it is found that the process is initially of much greater rapidity at elevated temperatures. In Fig. 4, for instance, are shown interlacing crystal formations at 70° F. after three hours, as contrasted with those at 50° F. after 10 hours. As the latter photographs show no visible change from their original appearance, temperature is evidently of great assistance in forming concentrated products.

It is further to be noted from these photographs that there is grouping together of individual particles, with less intense formation of cementing products at the boundaries of such groups than at single particles. If such grouping were to exist in concrete, much of the cement would be taken from points where it should be usefully applied, since hydration would soon begin to act to unite these groups inseparably. But since these groupings are always observed, such deprivation doubtless does take place, with resultant effect on the concrete. Furthermore, examination of commercial powdered cement reveals small aggregations present in infinite number, due possibly to hydration from moist air and sticking together before it reaches a user's hands. Evidently such groupings should be forcibly broken up either prior to or during mixing, and evidently, also, there is little use in finer grinding of cement unless such groups can be broken up.

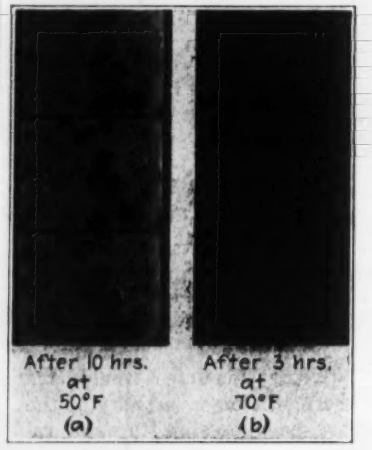


FIG. 4. HYDRATION OF PORTLAND CEMENT; CAMERA INTERVALS, 5 MINUTES

Grouping of cement particles rendering futile fine grinding

In addition to elevation of temperature, it is also found that intensive hydration can be brought about by violently stirring cement for periods longer than are usually employed, much as stirring sugar increases the sweetness of a cup of coffee. And it is further found that while sand grains poured into water are lifted bodily by tenacious air bells resident at irregularities in their surfaces, such air bells can be removed and full contacting of water (or of cementing solutions) brought about not by stirring alone, but by such violent stirring as to cause the attrition of particle on particle sufficient to bring about a scrubbing action. Considering these two phenomena in analogy, it is not improbable that the increased hydration of cement brought about by violent stirring is due to a removal of the protective skin from individual particles through such interparticle attrition, bringing about earlier and more prolonged chemical activity, as well as through the forcible breaking up of minute groupings before noted.

Combining these two benefits of removal of tenacious impurities and increased hydration by violently stirring cement and sand together in water, there is every element present of an improved process of making concrete, particularly as such violent stirring raises by internal friction the temperature of the mass, with further increase of hydration.

But what is the actual effect and result of this as expressed in accomplishment? Aside from increased hydration products as noted by the microscope, there is formed a viscous, coherent mixture, not inclined to separate even though very plastic, with little or no formation at the surface of fluffy "laitance." Remembering the levitation of sand grains in water by attached air bubbles, as well as the lubricative effect due to the mobility of gaseous bubbles in a liquid, it is not improbable that removal of such bubbles, together with the heavier specific gravity of the fluid brought about through increased solution of cement, has overcome the tendency to segregation usually present. Furthermore, it is at once evident that if increase of hydration can be assured, greater tolerance in the percentage presence of water is permissible, with increase of plasticity and ease of working, and, at the same time, assurance of a satisfactory result. Elimination of laitance and segregation on commercial operations would be of utmost importance, for materials so separated are almost valueless of themselves but would have high value if retained in their proper places.

And a corollary effect should be better compacting and greater solidity of the mass, with commensurate strength and endurance. If the particles shown in Fig. 2 had been closer together, solutions of cementing products at the surfaces of sand grains would have been stronger, through nearness to the source. Furthermore, a greater number of strong sand grains would have been present in any given volume. This result is sought in commercial work by spading, tamping or rolling, the last named being found by study to be preferable where the form of construction, as in roadways, permits of its use. Yet, if increased hydration is realized, together with very thorough distribution of such hydration products and detachment of air bubbles from sand and stone, a minimum of such artificial compacting is found to be necessary for a substantial improvement in texture and strength.

Furthermore, there should be less likelihood of points of weakness developing in such a product, either through the presence of an impurity at a center of disintegration or through loss of uncharged water, or through unequal internal strain due to nonuniformity. Study confirms this reasoning, for mortars (stuccos) and concretes reveal that three-branched cracks and their later ramifications are of primary origin, occurring at or about the time of set; and that they are induced by lack of uniform internal strength, for rupture comes suddenly, much as a sheet of paper might find relief from unbearable strain by rupturing abruptly about some point of weakness. (See Fig. 5.)

And, not least, disintegrations and softenings should, with such material, be at least mitigated, if not fully done away with. Disintegrations result from entrance of water into the body of concrete. Sea water carries so little material capable of attacking concrete that the entrance of many millions of gallons into the concrete is necessary for effective attack on a single cubic yard. Nor is the action of fresh water substantially different; and with this fluid the same requirement applies. As

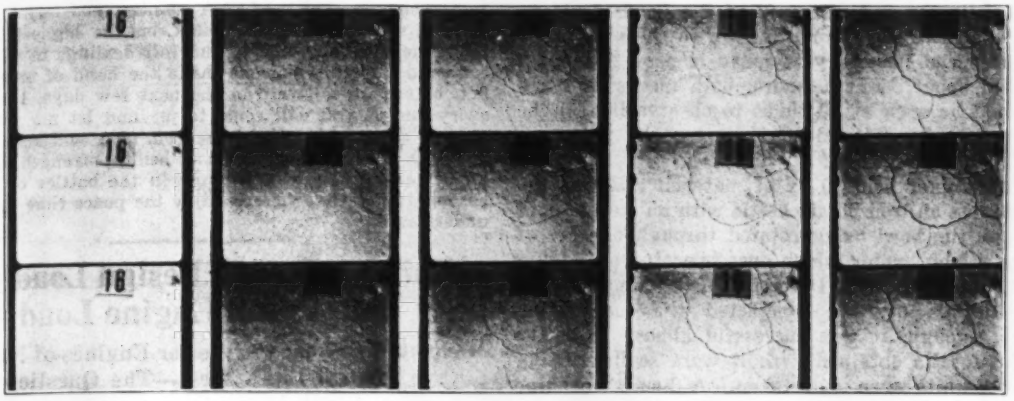


FIG. 5. FORMATION OF THREE-BRANCHED CRACKS IN STUCCO CAUGHT BY MOVIE CAMERA AT ONE-SECOND INTERVALS

Note that these originate at the surface pit seen in the upper right-hand corner

for rupture by rusting of reinforcement, the existence of this fault argues conclusively that water has reached the steel through the concrete, but when that happens, rusting, with expansion and rupture, is to be expected. On the other hand, given a uniform, dense concrete, without water or air voids, or laitance seams, or shrinkage cracks, the seas and lakes and rivers must confine

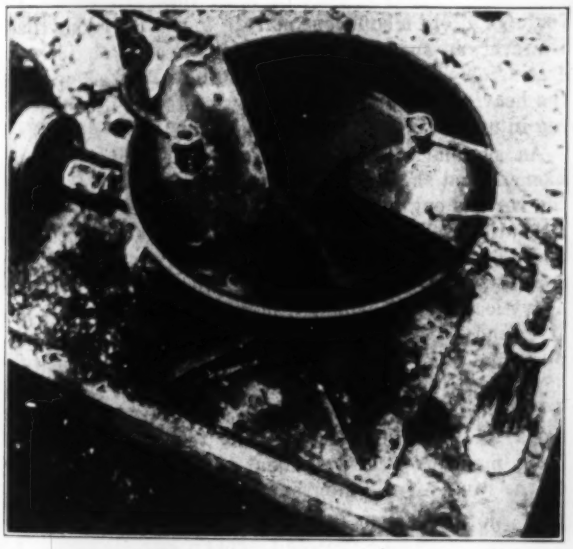


FIG. 6. FIRST CENTRIFUGAL CONCRETE-MIXING MACHINE IN ACTION. 10-INCH DIAMETER BOWL

their efforts to surfaces, instead of finding ready access to the interior, with proportionate endurance.

But however much laboratory experimentation may prove, conversion into commercial terms only will be of substantial benefit.

Early in this effort, existing forms of mixers were discarded as ineffective and not susceptible of necessary changes. With time ever a limitation, the first thought was to substitute rapidity of action for customary slowness. By the same agency, also, it was hoped to effect the violence that seemed to be necessary to force reluctant materials into proper usefulness. In addition to rapidity of action, repetitive cycles and a mass held compactly together to secure interparticle attrition were indicated. These constituted a new and different process from that heretofore used and demanded new means to effect it.

High rotative speeds imply centrifugal force as a concomitant. Centrifugal force would hold the mass of materials together, but would render inactive the usual drum mixer. Furthermore, a very small portion of available drum space in such machines is in active use, the overcapacity varying from 250% to 825% of the batch size in the products of 10 different manufacturers. It was also found that much useful mixing time was consumed in charging and discharging, batches having to enter and leave through severely constricted openings.

The expedient was adopted, therefore, of using an open bowl, rotated rather rapidly in a vertical axis. Centrifugal force would compact the rotating batch in the bowl and cause it to rise toward the top. At proper points, curved blades could cut off ribbons of material, diverting them to the center, so that repetitive cycles could be brought about. Discharge could be overside by utilizing the velocity of the mass, giving a high dis-

FIG. 7. THREE-CUBIC-FOOT CENTRIFUGAL MIXER IN ACTION

charge, while the full diameter of the bowl would be available for charging, doing away with the high elevation of material necessary to make it pass through a constricted spout. Furthermore, both mechanism and mass would be open at all times to observation. [The type of mixer here described is covered by patents—EDITOR.]

The first mixer held 30 lb. of material and was improvised from an iron potato kettle with an iron tamper for a base, the bowl being rotated through one set of gears by a ¼-hp. motor which once operated an adding machine. (See Fig. 6.) Diverting blades supported by small pedestals overside completed the mechanism. Strangely enough, it was successful almost from the first; and results obtained with it were so interesting that larger units were undertaken. A 3-cu.ft. machine was then constructed (Fig. 7) and later, a ½-yd. machine. Trials and tribulations were not few in number, but they are of no import in this discussion. Suffice it to say that a most intense action was secured, showing in practical result the actuality of the theoretical needs indicated by the reasoning before set forth.

Colonel Parsons' Address to His Men

ENGINEERS will appreciate the following heartfelt words by Col. William Barclay Parsons, now printed in the *Fighting Engineer*, the publication of the Eleventh Engineers' Association. It was delivered on the occasion of the regimental dinner at Hotel Pennsylvania in New York on April 30:

My men. I do not say officers and men, but, simply, my men. This is probably the only opportunity that I shall have to say a word to you all collectively.

In a few hours the process of disintegration will begin, and in a few days this regiment will exist in history only and the close comradeship that has held us for nearly two years will be at an end.

You and I have been together during that time, we have marched together by day and by night, we have worked and fought together in sunshine and in storm, in heat and in cold. We have been together and have seen our comrades fall, not to rise again, and we have stood side by side, with heads uncovered, as we laid them to rest in the far-away soil of France. Such a comradeship cannot be broken without a pulling of the heart strings. As you go on your several ways you will take with you my ever-abiding affection, and I hope that you are leaving me yours.

There are a few things that I ask you never to forget: First, and above all, the record of our regiment. That record, without a stain, without a spot, is yours. You made it, it is now yours to keep. In life let it be an inspiration to you, and when moments of temptation come, as they will come to all of us, let us remember that we belonged to the Eleventh, with its record second to none, and that it is the part of each one of us to live up to that record. You were willing to die for it; are you now willing to live for it?

It is right that men should make every effort, as men in Paris are now doing, to prevent war, but don't fool yourselves that there will be no more wars. Just so long as men are men, there will be wars and you will be called upon again. Unless the next war comes very soon, I fear that the operation of time will cut me out and it will be a younger and better man who will lead you on. For him, the best that I can ask is that you will give him the same loyal and faithful support that you have given me.

But while waiting for the next war of arms, remember there is always going on the war of good citizenship. In the war just ending you have done your duty; in the days to follow there is still a duty to perform. In your hands you have held the rifle and the pick, the weapons of the engineer; now you hold in your hands the ballot, the weapon of a good citizen. Use the latter as you have used the former, in the service of your country, and insist, as members of the Eleventh Engineers, on the highest ideals of law, order, decency, liberty and fair dealings to all men.

I cannot at this moment shake the hand of each of you, but, before we separate in the next few days, I hope that every one of you will come to me and let me give you a parting clasp. May God bless you, men, and keep you and give you, each and every one, all health, strength, happiness and success. May you triumph in the battles of life, and having gained that victory enjoy the peace that passeth all understanding.

Railway Bridge Design Loadings and Actual Engine Loads

Moment and Shear Curves for Engines of New York Central Lines West—The Question of Minimum Loading

BY B. R. LEFFLER
Bridge Engineer, New York Central Lines West of Buffalo, Cleveland, Ohio

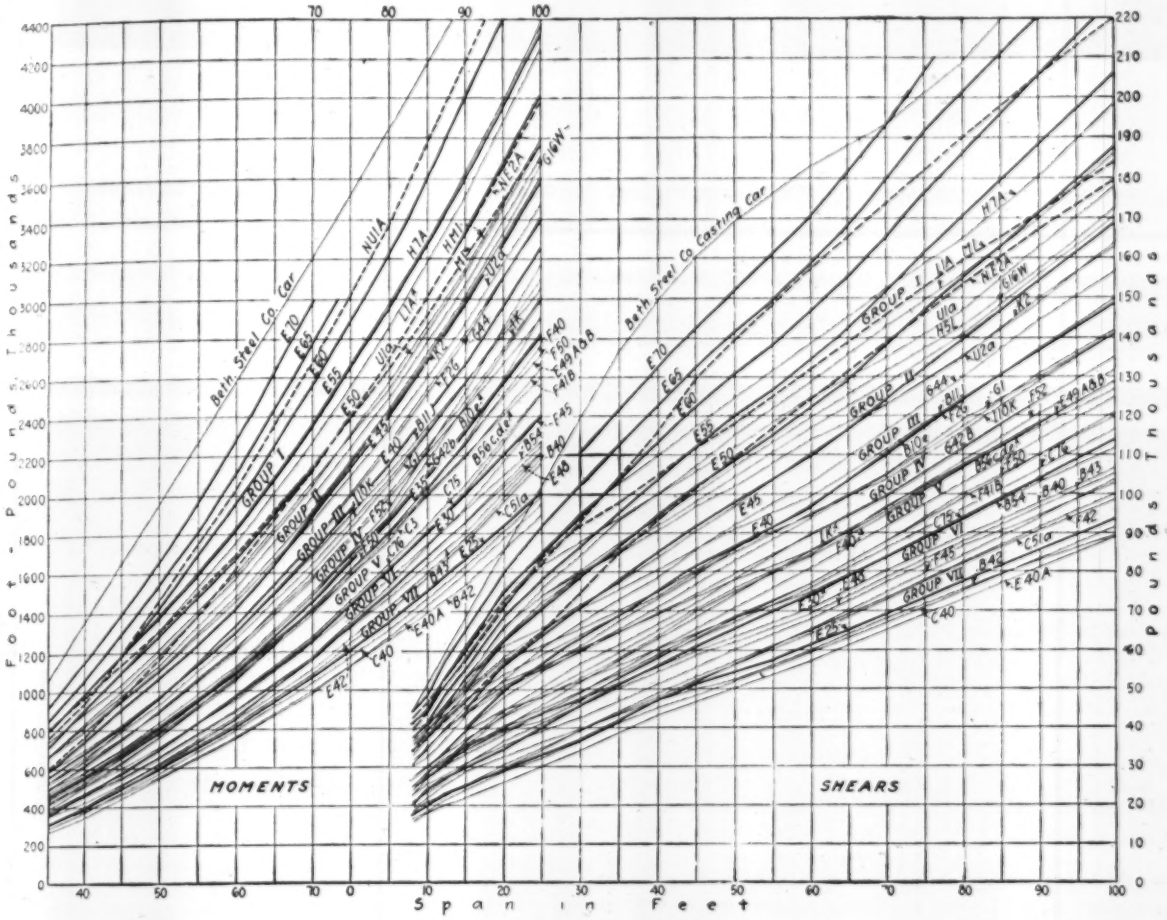
DEVELOPMENTS in railroad practice during recent years have carried engine and train weights slowly but steadily higher, until the margin between actual loads and current bridge-design loadings has become quite small. Recently, at the American Railway Engineering Association convention, remarks made in discussion of the subject of bridge specifications seemed to show a faith on the part of some that present design loadings afford a sufficient margin to last for a long time. However, an analysis of the bridge effect of engines operating on the New York Central Lines West shows that the heaviest power is very nearly up to the design loading in use today, and that special loads go even higher.

As summarized on the diagram herewith, showing moment and shear curves for spans up to 100 ft. under the various engines in use on the road, the actual loads are fairly well distributed over the range between E25 and E65. The engine designations given are those of the New York Central nomenclature. Two particularly heavy locomotives, which are also among the newest, are H7A and NU-1A. Engine H7A has four driving axles, pilot and trailing axle, and weighs 332,000 lb. without tender; its heaviest axle-load is 65,000 lb. Engine NU-1A is a Mallet with two sets of drivers, each of four axles; it weighs 622,000 lb. with tender. This engine has a moment effect equivalent to about E62 over most of the range of the diagram.

MOMENTS AND SHEARS COMPUTED FOR TWO ENGINES COUPLED

It should be said that in all cases moments and shears were computed for two engines coupled, except in the case of M1 and NE-2A, which were taken single, followed by a train of 115,000-lb. capacity cars. The NU-1A was taken single followed by a train of 70-ton capacity cars.

Wrecking cars were plotted on similar diagrams, but they produce considerably lower moments and shears than do the heavy locomotives. The heaviest wreckers do not exceed in moment 800,000 ft.-lb. per rail on a 40-ft. span. Still higher effects are produced by a heavy engine (N1S) of the Pennsylvania Lines West, which operates over New York Central tracks in Cleveland territory. It produces moments and shears exceeding those due to E70 loading. The engine is of the 2-10-2 type, has a length between couplers (tender included) of about 90 ft., and weighs 651,000 lb. with tender. Its driving wheel-loads range up to 39,000 pounds.



MOMENT AND SHEAR CURVES FOR ENGINES IN USE ON NEW YORK CENTRAL LINES WEST OF BUFFALO, AND FOR COOPER LOADINGS

Group numbers represent the classification of engines for purposes of defined bridge capacity

The moments *M* and shears *S* produced by this engine on various spans (compared with those due to E70 loading) are, per rail: On 40-ft. span, $M = 1230$ (1147), $S = 135$ (132); on 60-ft. span, $M = 2330$ (2274), $S = 169.3$ (171); on 80-ft. span, $M = 3600$ (3781), $S = 200$ (217).

Exceeding all the engines, a special car of the Bethlehem Steel Co., built for handling heavy castings, produces the critical stresses. This car has 60,000-lb. axle-loads, and its moment and shear effects are considerably above E70 on short spans. On a 100-ft. span the car produces a single-rail moment of 5126, while E70 produces a moment of 5635.

With this graphical comparison in mind, it is evident that no one can yet say what is to be taken as the heaviest railway loading. The fact that the upper lines in the diagrams represent engines added only in the past three or four years is an indication of the fact that the growth of loadings is still in progress.

Heavy motive power affects only the road on which it operates, of course. Freight cars, however, circulate everywhere, and it is difficult to exclude them from any particular division. This is especially true of coal cars, since coal must be carried to every station and to all railroad terminals.

It is found that 140,000-lb. coal cars, which are in use on the Pennsylvania and the Chesapeake & Ohio lines, are equivalent to about E45 for spans up to 40 ft., tapering to E36 for 100-ft. spans. Such rolling stock, then, would fix the minimum loading for which bridges anywhere in the country should be designed, no matter how light the power used on a particular road. From the diagram it can be seen that some of our light engines are below E30 in their effect. If a road used engines of this kind, however, and designed its bridges accordingly, the structures would be overloaded if a train that was composed of heavy coal cars were run over them.

The 140,000-lb. car is 43 ft. 8 in. long, 31 ft. 10 in. between the truck centers, and 5 ft. 10 in. in truck wheelbase. Its dead weight is 50,800 lb., and when loaded with a 10% overload (or 154,000 lb.) its wheel loads are 25,600 lb. On a 100-ft. span such cars would produce a moment of 2995 per rail, as against 2817 for E36 loading.

Edge Taping Strengthens Fiber-Board Boxes

Tests of fiber-board boxes in the box-testing machine of the Forest Products Laboratory, Madison, Wis., showed that failure usually started in the scores at the edges. When adhesive paper or tape strips were applied over the edges the strength of the box was increased about 25 per cent.

SOCIETY SERVICE

A Section Dealing with the Results of Teamwork by Technical Men

St. Louis Electrical Engineers Advise Development Committee

In order that the representative of the St. Louis Section of the American Institute of Electrical Engineers on the national development committee might have back of him, in tangible form, the local opinion which he represents, resolution were adopted pertaining to the relation of the institute to its members, to other engineering organizations and to the public. Briefly, they are as follows:

That annual visits be paid to sections by national officers; that institute meetings to be held bimonthly in the various sections' cities, on schedule; that expenses of board members be paid; that the country be districted and a vice-president elected from each district; that the *Proceedings* be changed to 9 x 12-in. size, contain articles of live interest, current topics as well as technical articles, editorial reviews, abstracts only of strictly technical articles, and advertising; that a National Engineering Congress be held biennially for the discussion of all matters pertaining to the general profession of engineering; that the section views with disfavor any thought of losing the identity of the institute through substitution of a common engineering body, but does favor affiliations along present lines through the United Engineering Society; that the Associated Engineering Societies of St. Louis is a model of successful federation; that members of the local joint council be automatically members of a National Engineering Council; that participation in all public affairs by the local federation or the national federation shall first be approved by the respective councils.

Iowa Publicity Committee at Work

An intensive publicity organization is being perfected in Iowa by the Iowa Engineering Society. Minutes of a recent meeting of a committee in charge of the work indicate a plan by which the state is divided into 11 districts, with a subcommitteeman in charge of each district and having under him local representatives.

On district organization the following rules were adopted: That members or nonmembers may be chosen as district committeemen or local representatives; that the main purpose of the work is to obtain publicity for the profession, its work and its relation to the public, and not publicity for the society; that individuals should be chosen who are or can become acquainted with the editors of the most influential papers. District committeemen are to enlist the services of local representatives to organize and supervise the publicity work in their respective districts; to furnish to the central office lists of representatives and newspapers and to report to the central office, sending clippings of articles published.

On the local representatives depends the success of the plan. They are to make the acquaintance of the editors; to prepare news stories of engineering of local interest, to procure news items of general interest for distribution through the central office, as well as obtain publication of similar items sent to them.

In a report on the functions and work of the committee, salient features that were brought out were as follows:

The fundamental principle in publicity work is that the engineer is a public servant and must render nontechnical as well as technical service. For the former the engineer is urged to ally himself with local nontechnical organizations. He should offer his ability as an organizer and specialist in materializing ideas promoted by such organizations. In the technical-service publicity the effort should be made to prove that the engineer is a financial asset to his community. Newspaper work should be supplemented by personal talks to individuals and by addresses. General instructions call for the maintenance of so high an ethical standard that the engineer will not indulge in or seek to obtain personal publicity at the expense of some other individual.

LETTERS TO THE EDITOR

Comment on Matters of Interest to Engineers and Contractors Will Be Welcome

Training in Latin and Greek Not Best for Engineers

Sir—Many years of study of the general subject of Latin and Greek as preparation for engineering, which subject is treated by Dr. M. E. Cooley as quoted in *Engineering News-Record* of May 8, 1919, p. 930, lead me to a conclusion quite opposed to the position taken by him. I am, therefore, led to offer the following principal reasons for my disagreement and my belief that these dead languages, if taught at all, should be incorporated into our teaching of English.

It is remarkable that this old controversy does not seem to down. On one side are men, some familiar with the ancient languages, who trace to them many advantages they have had from such knowledge, but ignoring the multitude of fellow students who, notwithstanding that acquirement, were never able to rise above mediocrity. On the other side are men who never studied Latin or Greek but, notwithstanding, have reached eminent positions in the world.

When a boy I studied Latin for four years and Greek for three. My study included some conversational "live" dialogues. All of this, I presume, fully meets Dean Cooley's prescription. Thus qualified, I shall try to be unbiased.

As all men differ in their capacities and opportunities, they should not and do not receive the same kind or extent of education. But, as of first importance, everyone of us should know as well as possible the language of his own country. Therefore, no education can be more valuable to an American "engineer trained for responsible citizenship" than to get a thorough knowledge of the use of the English language.

The study of the classics can have no influence whatever toward a better understanding of abstract sciences, such as logic and mathematics, or any of the concrete sciences, such as physics, chemistry, geology, astronomy, or

of the sciences of organisms, including their lives, from botany up to psychology, and even sociology. In fact, also the history of ancient civilization and of its stages of development can hardly be grasped by us in Greek or Latin as well as it can be in English when presented by specially trained linguists. The ancients at best had but rudimentary knowledge of all sciences and even less of the scientific method, which is gradually unravelling our most complex problems of practical life and our knowledge of all the fundamental inductions concerning our loftiest conceptions of religion, art and social life.

Greek and Latin of two thousand years ago do not and cannot give us, in any of these directions, what modern scientific knowledge and practical experience have given already and will surely continue to give; but they can give us something else. They can and do help us to understand and use the English language more accurately than by a knowledge merely of its words learned in childhood.

When I first gained this opinion, I asked myself, How then should I study Greek and Latin? As I had studied them? No. As my children studied them? decidedly, no. How, then, should they be taught?

Most thoroughly to understand and use a language, one should know, besides the meaning, also the derivation and life of its words, the way to form its sentences, and the relation of words and sentences to express our feelings, thoughts and conceptions. The English language was once Anglo-Saxon and into it were transfused later more than half of its words from the Norman-French after the conquest, and finally, for advanced knowledge, words from the Latin and Greek.

Therefore, we should be informed by our teachers, as in an interesting story, how the words of the English language were developed from crude origins, how they were influenced by internal and external causes, how and why they were changed from one period to another and gradually arrived where they are today—in short, we should learn the story of the life and growth of our language.

Such a story would raise a lasting interest in the growing young mind. As a first reading book, the edition of "Robinson Crusoe" written in monosyllables, almost all of Anglo-Saxon origin, might be an entertaining help. The history of the peoples who spoke these four languages—Anglo-Saxon, Norman-French, Latin and Greek—should then be learned, in order that the student may understand how and why their words and expressions were finally united with and converted into modern English.

For instance, under which conditions did our language ancestors derive their words, and which conditions caused the gradual changes in the words? What were their grammatical forms, compared with one another? Why and how did the Anglo-Saxon forefathers take over so many of its words and forms of sentences from the French language? And, finally, how were new words created to express the multiplying new ideas and conceptions, by utilizing Greek and Latin roots? Spencer says, "the development of language is a psychological process determined by social conditions."

Pari passu with these interesting stories to be told by the teacher, the young folks should memorize actual words of those old languages, with their original meanings and as used in conversational phrases, selected to cover those words that were gradually embodied in modern English. The words learned should not be vocabularies having no reference to modern English. Let us learn, for instance, the origin of the words "home," "love," "children," etc. Let us know when we see the word "geography" that it is made up of two Greek words, "*ge*," earth and "*grapho*," to write. Let us learn the declensions and conjugations in order to form simple sentences and phrases in those old tongues and so as to give the words life and interest in relation to our new tongue.

If Greek and Latin and also Norman-French and Anglo-Saxon were studied in this manner—and I see no reason why they could not be—we should better understand the spirit and weight of our words and sentences. Incidentally, we should automatically not be tempted to write the word "seperate" instead of "separate," nor say "this data" and "this phenomena" instead of "these data" and "these phenomena." Nor should we mistake the nominative for the accusative case, as is so often done, nor make any other misuses which together mean "bad" English. Our dictionaries have a list of phrases and expressions, mostly in Latin, which are used by us daily. Let us learn them early, with their original meanings, so that they are understood and correctly used—generally to differentiate or specialize the meanings when the phrases or expressions are interpolated in an English sentence.

It has seemed to me that if the study of these ancient languages were taught not as a "fad," which is evidently the case at present, but for real, practical, intellectual usefulness, we should read and hear a better language today than we do. All this interest and benefit could be obtained from efficient teachers trained along philological lines, in a fraction of the time now spent. One or two semesters at the utmost should suffice amply for teaching each one of our parent languages for the above purpose, including the interesting histories of their developments.

Why should we weaken our modern education by antiquated methods, surviving from the Middle Ages, when Greek and Latin were the only languages of culture and the only means of preserving the records of civilization and intercourse between the intellectuals of different nations? A thousand years ago the preservation of these languages was necessary, because without any printed books for general distribution there was a gradual breaking up—a vulgarization, for instance—of Latin into Italian, French, Spanish, Portuguese and Rumanian.

In our present age, however, with the constantly growing mass of necessary and useful knowledge which is pushing civilization ahead, it is becoming absolutely necessary to economize in our studies and in the time which can be devoted to them. The study of the ancient languages as above outlined would seem to be ample, if indeed such knowledge is at all necessary for most of the intellectuals of modern times. John Bright, Herbert Spencer and others who wrote excellent English say that their knowledge of Greek and Latin was not worth mentioning. The "humanists" of the Middle Ages should be transformed into "humans" of today. Waste, through conservation, should be converted into economy; extravagance, through limitation, into frugality.

One of the pet reasons given for studying Greek and Latin is to get "mental discipline." Faraday says that

"science is greatly superior to language as a means of discipline," and that it "culivates our judgment more safely and intensely." The best discipline arises when we act under laws and rules *without* exceptions, as in any scientific pursuit. The ancient languages have many exceptions to their rules, concerning genders, declensions, conjugations, etc., and even their sentences, as I remember, are not always as logical as algebraic expressions must be always.

Another of the pet reasons for holding on to Greek and Latin in the schools is that we may read the "classic literature of the ancients," which has been held as a model for civilization for several thousand years. How many Greek and Latin students of the present century are able to read, understand and really enjoy that literature in the tongues in which it was originally written, even if their minds could take themselves back into the actual state of civilization then existing?

Those who live today and must look upon the ancients as historical relics—magnificient and interesting in a museum, if you please—can certainly acquire more benefit and enjoyment by reading that same literature in the best translations, into English, French and German, of every ancient writer worth considering. Neither Americans nor Western Europeans need learn Greek and Latin for that purpose.

Finally, with reference to the editorial remark that colleges of literature and arts turn out men of more breadth and culture than engineering colleges: This may unfortunately still be true, but the reason, so far as my experience has gone, is not the study of Greek and Latin. There is another cause. The universities formerly had a rank much higher than that of the technical schools. Fifty years ago I heard it said, somewhat to my disgust, "Oh, he is not able or bright enough to study law or medicine; he must take up some engineering occupation or trade." Families of higher culture are apt to produce boys and girls of greater mental capacity and breadth. Their sons, therefore, as a rule were sent to the universities, and those who could not stand the greater strain selected engineering. This feeling was particularly common in England and Germany. It was not so in France, where engineers came often from the best families and socially had a higher standing than in any other country. M. Freycinet, for many years head of the French cabinet, was an engineer.

Greek and Latin have been studied within the past century mostly by those expecting to follow the legal and medical professions, rarely by engineering students. The lack of knowledge, until recently, concerning the origin and course of diseases was such that 39 years ago no less a person than Dr. Pettenkofer said to me: "In but few cases can we do more than make the best guess that our experience justifies." Since the advent of bacteriology, and progress along other lines, the medical profession has moved ahead with leaps and bounds, so that within a third of a century both death and sick rates in the most highly civilized countries have dropped in a great ratio than during many centuries before. Neither Greek nor Latin helped in this advance.

Since the Middle Ages even the greatest of the creating artists in music, painting, sculpture and architecture were not specially versed, if at all, in these ancient languages.

The engineering and allied professions, the students of which generally have not been obliged to study Greek and Latin, have contributed more to advance modern civilization than any of the above professions. By studying and utilizing the laws of nature, they have made it possible to travel over land and sea without limit and open up the possibilities of the entire earth for the benefit of men. They have introduced more rapid means of mental communication through the telegraph and telephone, without which the amount of our progressive work of today would be very greatly diminished. The achievements of mining, manufacturing, sanitation and agriculture during the past century did more to advance the human race toward higher planes than was done in any previous equal period.

I heartily agree with your correspondent in the issue of May 22, 1919, p. 1031, in his reference to Herbert Spencer, whose essay on "What Knowledge Is of Most Worth," written about 60 years ago, pretty thoroughly settles the question as to the relative value of the "classics" and of modern sciences. As Spencer in his early life had been an engineer himself, Dean Cooley should take that philosopher's opinion as applying especially to engineering students, and "as a means of training (them) for responsible citizenship."

New York City. RUDOLPH HERING,
Consulting Engineer.

The Manning Formula Again

Sir—Considering the discussions that have recently appeared in *Engineering News-Record* [see *Engineering News-Record* of Jan. 16, 1919, p. 149; Mar. 13, 1919, p. 536, and Apr. 3, 1919, p. 685] regarding the treatment of the Manning formulas in the Miami Conservancy District's Technical Report, Part IV, it seems pertinent to add a few remarks concerning these equations.

Up to the time Professor King's "Handbook of Hydraulics" was published, which was after the manuscript for Part IV had gone to the printer, the equation generally known as the Manning formula had been mentioned but briefly in American engineering literature. For this reason, although it was known that the formula is used to a limited extent in certain foreign countries, it was not considered necessary to publish a detailed treatment of the equation, especially as our investigations had led to the conclusion that nothing could be gained by its use.

The formula recommended by Manning, given on p. 221 of Part IV, never found any appreciable acceptance among practicing engineers, although it is, next to the Ganguillet and Kutter formula, the best one so far proposed. It was this equation that was referred to on p. 243 of Part IV in the statement: "The average error of the results calculated by the Manning formula for the gagings of Humphreys and Abbot was 19.8%, while the average of those calculated by Kutter's formula for the same gagings was only 4%." These average errors were determined by Manning in a manner similar to that used by Leach in calculating the "average departure from mean" (*Engineering News-Record* of Mar. 13, 1919, p. 536) and consequently would not be affected by constant errors in velocity measurements.

The equation now known as the Manning formula is merely an exponential formula in which the coefficient is given as a function of n. It would have been discussed under the heading "Exponential Formulas," in Part IV, if it had not been for its connection with the

VARIATIONS IN VALUES OF KUTTER'S n AND MANNING'S n CALCULATED FROM EXPERIMENTAL DATA

Description of Data	Number of Experiments in Series	Average Values K's n	Average Values M's n	Difference in % of K's n	Average Variation* K's n	Average Variation* M's n
Experiments 16a and 17a, Table 112, King's "Handbook"	2	0.0127	0.0137	7.9	2.36	9.48
Experiments 18a and 19a, Table 112, King's "Handbook"	2	0.0124	0.0121	2.4	0.81	2.48
Experiments 46, 48 and 50, Table 112, King's "Handbook"	3	0.0194	0.0198	2.1	3.95	3.88
Experiments 47 and 49, Table 112, King's "Handbook"	2	0.0184	0.0190	3.3	4.35	6.31
Experiments 60a to 63a, Table 112, King's "Handbook"	4	0.0119	0.0116	2.5	4.83	5.17
Experiments 65 to 68, Table 112, King's "Handbook"	4	0.0130	0.0127	2.3	7.31	7.08
Experiments 137 to 140, Table 112, King's "Handbook"	4	0.0193	0.0196	1.6	1.82	1.78
Experiments 206 to 208, Table 112, King's "Handbook"	3	0.0281	0.0314	11.7	3.20	4.77
Experiments 247a and 248a, Table 112, King's "Handbook"	2	0.0524	0.0711	35.7	0.96	0.56
Bazin's Series 6, "Récherches Hydrauliques"	12	0.0127	0.0125	1.6	1.1	1.27
Bazin's Series 7, "Récherches Hydrauliques"	12	0.0120	0.0118	1.7	1.0	0.99
Bazin's Series 8, "Récherches Hydrauliques"	12	0.0116	0.0114	1.7	2.5	1.67
Bazin's Series 9, "Récherches Hydrauliques"	7	0.0130	0.0129	0.8	1.2	3.24
Bazin's Series 10, "Récherches Hydrauliques"	7	0.0117	0.0115	1.7	1.4	0.71
Bazin's Series 11, "Récherches Hydrauliques"	7	0.0113	0.0111	1.8	3.8	2.12
Bazin's Series 12, "Récherches Hydrauliques"	7	0.0151	0.0153	1.3	1.0	1.31
Bazin's Series 13, "Récherches Hydrauliques"	7	0.0148	0.0153	3.4	1.2	1.87
Bazin's Series 14, "Récherches Hydrauliques"	7	0.0150	0.0155	3.3	1.8	0.92
Bazin's Series 15, "Récherches Hydrauliques"	7	0.0209	0.0223	6.7	1.2	2.76
Bazin's Series 16, "Récherches Hydrauliques"	7	0.0212	0.0232	9.4	1.6	2.46
Bazin's Series 17, "Récherches Hydrauliques"	7	0.0215	0.0237	10.2	2.2	1.51
Bazin's Series 32, "Récherches Hydrauliques"	4	0.0168	0.0177	5.4	0.4	1.69
Bazin's Series 33, "Récherches Hydrauliques"	4	0.0171	0.0177	3.5	1.2	2.26
Bazin's Series 44, "Récherches Hydrauliques"	4	0.0195	0.0202	3.6	8.8	10.64
Bazin's Series 46, "Récherches Hydrauliques"	4	0.0205	0.0212	3.4	5.7	7.54
Tadmor experiments, 2, 4, 6 and 10, Table 9, Pt. IV	5	0.0316	0.0305	3.5	4.9	4.59
Ark. ditches, experiments 40 to 45, Table 9, Pt. IV	6	0.0342	0.0317	7.3	1.6	2.94
Total number of measurements	241	Mean Variations		10.1	3.58	5.02

* Average variation from mean in per cent. of mean value.

original Manning equation which is not of the exponential type. Manning investigated this equation, in a slightly different form, and rejected it because it did not give satisfactory results for the Mississippi River gagings. Bazin, in his paper in "Annales des Ponts et Chaussées," 1871, entitled "Étude Comparative des Formules Nouvellement Proposées Pour Calculer le Débit des Canaux Déconverts," showed that an exponential formula is not the proper kind of an equation to represent the conditions of flow in open channels. He showed that the curve is not the right kind of a curve, that while it may be made to fit a small range in conditions in a given case, by varying the coefficients and exponents, it cannot be used as a general formula.

One way in which the Manning formula may be compared with Kutter's is to calculate, by the two equations, the values of n for several series of measurements, in channels where *the roughness conditions are constant* and then to compare the constancy of the calculated values. This method was used in several instances in Part IV. The method used by Leach in his studies, referred to above, was similar, except that he assumed that the roughness factor for a given channel should be the same for all stages, irrespective of actual differences in roughness conditions. Mr. Horton, in his reply to Mr. Leach, has already called attention to the great differences in actual roughness that may exist in a given channel with different stages. The Tadmor measurements, which Mr. Leach used and to which he gave greater weight than to any of the others which he investigated, may be cited as an example of such conditions. The experiment, made during the 2-ft. stage of September, 1916, which causes the Manning formula to appear so much better than the Kutter formula, was made when the water was comparatively low. For such stages the channel is smoother than it is during flood stages, when the other measurements were made. The bed and banks are more regular, and the disturbing effect of the fringes of trees along the banks, which is very marked during flood stages, is entirely absent. While this was not emphasized in our report, it was mentioned in the descriptions of the Tadmor measurements and also on p. 142. For the above reasons this experiment was omitted from the Tadmor series in the studies given on pp. 239, 243 and 260 of our report, and also in the study of the Manning and Kutter formulas given in the accompanying table.

The table printed above gives, for each of several series of measurements, the average value of Kutter's n, the average value of Manning's n, the difference in the two values expressed as a percentage of Kutter's n, the average variation in Kutter's n in per cent. of the mean value, the average variation in Manning's n, and the number of measurements in each series. It also shows the mean values of the average variations of the two factors and of the actual differences in the factors for the entire group of 241 measurements. The data chosen for this study include those used in comparing the Bazin and Kutter formulas, on p. 260 of our report, and also such data given in Table 112 of Professor King's "Handbook of Hydraulics" as might properly be used for this purpose. Owing to the fact that the calculations were made at different times, some of the values of average variation of Kutter's n are computed to tenths of a per cent. only, instead of to hundredths as are the others. However, this has no material effect on the results.

A study of the results given in this table shows some interesting conditions. A comparison of the last two columns shows that the average variation of the Kutter roughness factor is the greater in 12 cases and the less in 23. The mean variation of Kutter's n for all measurements is 3.58%, while the mean variation of Mannings' n is 5.02%, or about 40% greater. The difference between the absolute average values of the two coefficients varies from 0.8 to 43.5%, the mean value for the 35 locations being 10.1%. If the experiments made on the Bogue Phalia, the Mississippi, the Irawadi, and the Volga are omitted (the only ones made in channels of unusually large size) the mean variation of Kutter's n is 2.67%, the mean variation of Manning's n is 3.41%, and the mean difference between the two roughness factors is 5.18 per cent.

This shows that Kutter's formula is better for channels of ordinary dimensions as well as for channels of unusual size. In view of the large number of diagrams and tables that are available for aid in using the Kutter formula, the advantage of simplicity possessed by the Manning formula does not seem to be of great importance, certainly not of sufficient im-

portance to warrant its general adoption and the rejection of the Kutter formula. While the Manning formula might be used in approximate calculations, as might also several other equations, it would seem to be better to use the Kutter formula in all important calculations in channels of ordinary dimensions as well as in channels of unusual size. Although the Kutter formula is not ideal, it is the best we have at the present time.

IVAN E. HOUK.

Miami Conservancy District, Dayton, Ohio.

United States Chamber of Scientists Proposed for Engineers

Sir—I have read with much interest W. L. Saunders' article in your issue of Apr. 17, 1919, p. 756, on an Engineering Civic Federation. It appears to me to be the most practical and logical solution of the many troubles that beset the engineering profession at this time, but I would go farther.

Everyone is doubtless familiar with the activities and influence of the United States Chamber of Commerce in the commercial world. The federation proposed by Mr. Saunders would have a similar influence and effect on engineering and all scientific progress and civic betterment if open to all technical, scientific and engineering societies, to all technical engineers, surveyors, architects, and, in general, to scientific men or women who work with their brains more than with their hands in engineering and science in all branches.

Mr. Saunders has well said that engineering societies are not effective in public matters. The public and legislators cannot be made to believe that their aims are unselfish, although these classes are the most altruistic of the human race. One does not have to go far to discover the reason for this. Scientific men and engineers are all technical and the public and legislators do not want technics, but policy and (we trust) public betterment.

I remember very well when this fact was first brought home to me in the late '80s when the late E. L. Corthell, Lyman E. Cooley and several others, including myself, then secretary and director of the Southern Society of Civil Engineers, prepared a bill for the establishment of a Department of Public Works to take over the river and harbor work of the national Government and place it in the hands of the civil engineers. The bill was promptly killed as "class legislation."

The engineers in this country are, however, very restless, and something must be done to better their condition, which is certainly deplorable when compared with that of the workmen under them. This condition has been brought about largely by the action of the War Department in this war in establishing the rank of "engineer" from men more noted for their brawn and fighting ability than for their engineering knowledge, in many cases. Pick-and-shovel men, railroad trackmen and trainmen, chauffeurs and auto-repair men and even lumberjacks were all called "engineers," and the general public does not discriminate.

These conditions must be radically changed, and the American Association of Engineers and Engineering Council are doing a praiseworthy work, but they cannot reach the great mass of the people, and so wield an overpowering influence as can a chamber of science, with a membership of half a million.

Important as the salary question is, it is not everything, and the result can perhaps be brought about in a more dignified and desirable manner. My old professor urged his students to give no thought to pecuniary emoluments but to rest assured that with professional success "all these things would be added."

I do not like the word "federation." It savors too much of a labor union. I prefer United States Chamber of Scientists. If the public knows that half a million voters are behind us we carry far more prestige than 50,000 could possibly do, and if a measure is before Congress it may be embodied in a bill that will not appear selfish, sordid or as class legislation, but, as the Chinese told his partner, who objected to certain items not being specified in a bill they were about to present, "You no see 'em, but they there allee same."

And now comes the report that the Boston engineers have joined the American Federation of Labor, a trade union. Shades of the immortal Stevenson, Roebling, Eads and Francis! And this is the modern Athens, city of culture and of the Pilgrims, and my birthplace!

Everyone should read the admirable article by Mr. Saunders and also the able address of W. W. K. Sparrow, chief engineer of the Chicago, Milwaukee & St. Paul R.R. printed in the April number of the *Monad*, the organ of the American Association of Engineers, both of which advocate a chamber of commerce of engineers along similar lines. No better man can be found for president than Maj. Gen. George W. Goethals, as proposed by Mr. Saunders. I have had the pleasure of knowing him for nearly 30 years. One of the first activities for this chamber of scientists to undertake will be educational and missionary work among the people, and especially among the engineers of Boston.

J. FRANCIS LE BARON,

Panama City, Fla. Consulting Engineer.

Variation of Roughness Coefficient in Manning's and Kutter's Formulas

Sir—Concerning the correspondence in your issue of Jan. 20 and Mar. 13 under above heading, and also Mr. Houk's most interesting report on the "Calculation of Flow in Open Channels," I trust the following statement will not be regarded as controversial:

I notice that all of the engineers concerned use the gagings of the Irawadi at Saiktha as an example. I have a very high respect for those investigations, but I think, considering their date and the methods used, that it is unwise to regard them as sufficiently authoritative for testing the newer standard formulas. The exigencies of the war have separated us from libraries, so I speak from memory, but I believe that (1) these experiments were made before 1880; (2) the standard apparatus was the twin float, though current meters of an experimental type were also employed; (3) the results when plotted against any of the newer standard formulas, Bazin's (1899) or Manning's, are less concordant than the average of modern observations.

For their date the Irawadi experiments were first-class, but I think that in the present state of knowledge they, like the earlier Mississippi work, should be considered as second-class only.

I would add that for the present purpose, their selection, even if they were first-class, appears unfortunate. The investigation is concerned with changes in Kutter's (or Manning's) n and Bazin's γ produced by variations in gage heights. The Saiktha gage site is situated up-

stream from a bar and crosses a deep pool. Thus, the conditions affecting the connection between the gage height and the discharge must be abnormal when compared with those existing in the ordinary cases to which it is desired to apply the results of the investigations.

Kuala Lumpur. P. PARKER.

Definition of Engineering

Sir—Writing definitions of human vocations is not a simple matter, as Mr. Condron has doubtless found out, judging from your issue of May 29, 1919, p. 1079.

Attempting to make a suggestion, a definition of engineering was formulated, containing 72 words. By revision, it was reduced to the form which follows, containing 45 words. This is thought to be sufficiently inclusive and not too inclusive. It is not the result of the effort of one mind, but rather of the efforts of three minds.

For use in license laws it seems to be desirable to define not only engineering but professional engineering, or perhaps a professional engineer. Therefore, a definition of professional engineer is added:

Engineering is the intelligent application of the laws of mathematics and physics and often those of other sciences in the design, construction and operation of machines and the physical structures of public and private enterprises, and in the discussion, investigation and solution of related problems.

A professional engineer is one whose vocation is engineering. APPLIED SCIENCE.

Classes Draftsmen With Engineers

Sir—In your issue of Apr. 24, 1919, p. 834, Thomas P. Morrissey makes a statement to the effect that draftsmen are to be classed in the same category as bricklayers, carpenters and other mechanics. He then asks these questions: "Are they engineers? Tell me, now, are men of this type qualified to receive as much or more than mechanics? What do you mean when you say 'engineer'?"

Of a similar tenor are the remarks of Palmer C. Ricketts in your issue of May 29, 1919, p. 1075 where he says, "The difficulty is that common surveying and ordinary drafting are not difficult to learn and the law of supply and demand takes care of the pay for this kind of work. It is also a fact that a good carpenter is often worth more to a community than a good leveler or a good draftsman."

Now, giving the matter honest and due consideration, is it really fair, just, or even correct to give the young graduate engineer who is serving as a structural draftsman a classification on a par with, or even lower than a mechanic? Take my own case, which is fairly typical. During the summers of 1913, 1914 and 1915 I earned a part of the expense of technical training by working at the carpenter's trade, and I am capable of holding the best kind of a carpenter's job today. From this experience I can say that any lively young man with a whit of mechanical ability can learn the carpenter's trade in six months.

Engineering knowledge is not gained with any such ease. If, then, the difficulties in becoming proficient as a competent structural draftsman are to have anything to do with his worth as compared with that of the carpenter, the odds are heavy in favor of the structural draftsman. Moreover, the draftsman in preparing his drawing lays out the work and directs the activities of mechanics. Is it not usually considered in the industrial world that the man who directs the activities of others is to be given compensation and rank above them?

On the other hand, how many mechanics can be found who are competent to prepare a rational and economical design in structural steel or reinforced concrete? It may not be the constant duty of the structural draftsman to perform such work, yet it is required of him at times, and he is expected to be able to do it at any time. To suggest that a carpenter or mechanic could do it, or attempt it, is positively absurd.

It is true that complaint regarding the classification and pay for engineering services has come largely from draftsmen and instrumentmen. And the reason is this: Compensation for a mechanic's services in 1914 was less than for the draftsman. Since that time the increase in pay of the former has kept pace with the increased cost of living because of his union and the urgency of war work. The draftsman's pay, however, has not kept pace with the increased cost of living and today he is paid no more than the mechanic and, in some cases, less.

Our Government has compiled figures to show that the increase in cost of living has been 66% since 1914. Draftsmen's salaries have increased a spare 25 to 30%. Mechanics' wages have increased the full 66% and in some cases have doubled.

Now, as to "What is an engineer?" and "Is a structural draftsman an engineer?" I should say that an engineer is a man who has, by endowment and development, what I would call the engineering mind. The engineering mind works in two phases, the analytic and synthetic, to direct the forces of nature toward the upbuilding of modern industry, and for the benefit of mankind.

In order so to direct the forces of nature, the engineer must conceive a structure, a machine, a railroad, a plant, or perhaps a whole industry. Such a conception takes place in the mind of the engineer and must be presented to the minds of other engineers and workmen before it can become a reality. This presentation is usually made through the medium of an engineer's drawing. Here is the function of the engineering draftsman.

Usually the engineer does not make his own drawing but details this work to another engineer—a draftsman, usually younger, of less experience and naturally subordinate to his instructions. I have called a draftsman an engineer because he must have, to a certain degree, the same engineering mentality or mind as has his superior, else he will not efficiently and successfully grasp the conception which his superior holds in mind, and place it for him into an intelligible drawing. I would say, then, that a draftsman, if competent, is a minor or junior engineer, but an engineer, nevertheless.

I am not alone in this opinion. For example, in "Design of Plate Girders" by Lewis E. Moore, associate professor of structural engineering at the Massachusetts Institute of Technology, occurs the following: "The draftsman who plans his work with reference to needs of the shop and erection department, while carry-

ing out the intention of the designing engineer, is entitled to a part of the credit for the completed work and may rightfully feel that he is an engineer, not a mere mechanic."

A. F. FOWLER.

Detroit, Mich.

Chart for Estimating Motor Truck and Trailer Haulage Costs

Sir—The writer has read with interest several articles appearing in *Engineering News-Record* relative to the operating cost of a five-ton truck. I am sending you herewith a chart which was compiled originaliy for the purpose of comparing the operating cost of a five-ton truck and a five-ton truck with trailer. The chart is based on the assumption of a five-year life of the truck, averaging 300 days per year.

It is, of course, impossible to make any rule which will fit all the various conditions encountered in motor-

OPERATING COST OF A 5-TON TRUCK

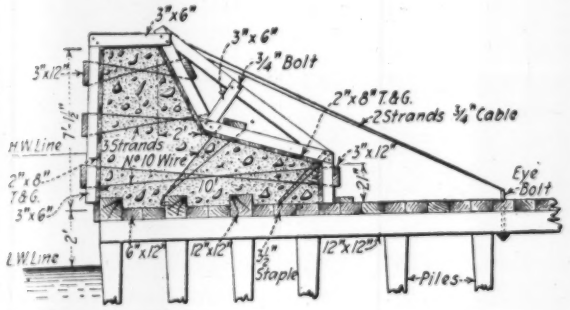
		DAILY	Mile	10	20	30	40	50	60	70	80	90	100	110
FIXED CHARGE	First Cost $6000	$ 4.00												
	Driver	4.25												
	Interest @ 6%	0.75												
	Insurance	1.50												
	Overhaul 60¢	2.00												
	License 60¢	0.20												
	Maintenance	0.30												
	Total	$ 3.00												
MILEAGE CHARGE	Gasoline and Oil		0.08	0.60	1.60	2.40	3.20	4.00	4.80	5.60	6.40	7.20	8.00	8.80
	Tires		0.05	0.50	1.00	1.50	2.00	2.50	3.00	3.50	4.00	4.50	5.00	5.50
	Total			1.13	1.43	1.56	1.69	1.82	1.95	2.09	2.21	2.34	2.47	2.60
	Helper @ $3.00		$	1.13	1.43	1.56	1.69	1.82	1.95	2.09	2.21	2.34	2.47	2.60
				1.73	1.73	1.86	1.99	2.12	2.25	2.38	2.51	2.64	2.77	2.90
				1.73	1.73	1.86	1.99	2.12	2.25	2.38	2.51	2.64	2.77	2.90
				3.00	3.16	3.42	3.68	3.94	4.20	4.47	4.72	4.98	5.24	5.50
			$	4.13	4.30	4.56	4.82	5.08	5.34	5.60	5.86	6.12	6.38	6.64

HINTS FOR THE CONTRACTOR

DETAILS WHICH SAVE TIME AND LABOR ON CONSTRUCTION WORK

Unit Form Permits Building Concrete Wall on Pier Edge

CONCRETE bulkhead walls on the water side of piers present some difficulties in construction, on account of the necessity of having outboard bracing, and also because of the possible entrance of water into the forms with the rise of tide or water level. The form shown in the accompanying sketch was used by



FORM FOR CONCRETE WALL ON EDGE OF PIER

Henry Steers, Inc., of New York City, in the construction of a pier in Brooklyn and was devised to meet the difficulties.

Forms are built in panels 15 ft. long, are moved from place to place, and are used successfully several times over. Each panel consists of transverse frames, made up of 3 x 6-in. sticks spaced 5 ft. c. to c., with outside and inside lagging of 2 x 8-in. tongue-and-groove planks, the whole resting on the timber framing of the pier proper. The form is held against outward movement by the two strands of ¾-in. cable fastened to the upper bolt of the frame and to an I-bolt back on the pier. The form is wired together, as shown, against interior buckling, and held down to the pier proper by wires attached to staples in the deck.

The sections are quickly erected with the aid of a floating derrick. Concrete is started as the tide recedes below the level of the deck, and it has been found that the 2 x 8-in. tongue-and-groove boards offer sufficient protection to the concrete against scouring action of the rising tide.

The form was described in the "Contractors' Atlas" of June, 1919, by A. R. Moxter, superintendent of construction of Henry Steers, Incorporated.

Short Straight-Edge With Handles for Use on Narrow Widths

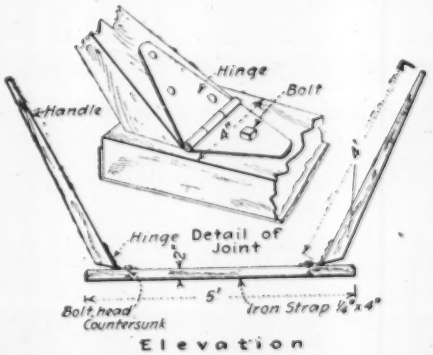
BY GEORGE W. MCALPIN
Point Pleasant, W. Va.

A CONVENIENT, short straight-edge for leveling off concrete paving in narrow widths is shown herewith. With this tool it was found that two men could easily accomplish the work previously done by four, operating the old type without handles.

Other Articles in This Issue of Interest to Contractors:

Storing and Handling High Explosives During the War — Page 1242
Enlargement of the Yakima-Tieton Main Canal — Page 1255
Sinking and Concreting Mine Shaft 936 Feet Deep — Page 1259
Important and Neglected Features of Tire Maintenance — Page 1262
Bettering Concrete by a New Mixing Method — Page 1266

It is made of a 2 x 4-in. scantling, laid flat, and is provided with an iron strap, ¼ in. thick, on the bottom. The handles are so attached by strap hinges and one bolt that they may be moved in two directions. This



DETAILS OF SHORT STRAIGHT-EDGE—NOTE DOUBLE HINGED JOINTS

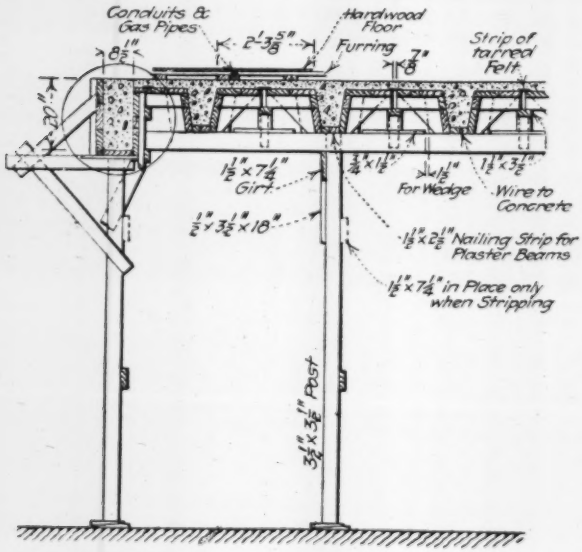
permits the operators to work from a standing position, instead of the kneeling position required for operating with efficiency the straight-edge of the ordinary type.

The double-hinged joint also permits the usual sawing motion that is employed in the cutting off of concrete surfaces.

STRAIGHT-EDGE WITH HANDLES IN OPERATION ON NARROW PAVEMENT

Forms for Concrete Floor Made Up of Wood Frame Sections

SECTIONAL wood forms, of inverted-trough section, were used over and over again in the construction of the floors of a reinforced-concrete apartment house at Salt Lake City, Utah, by Villadsen Brothers, Inc., con-

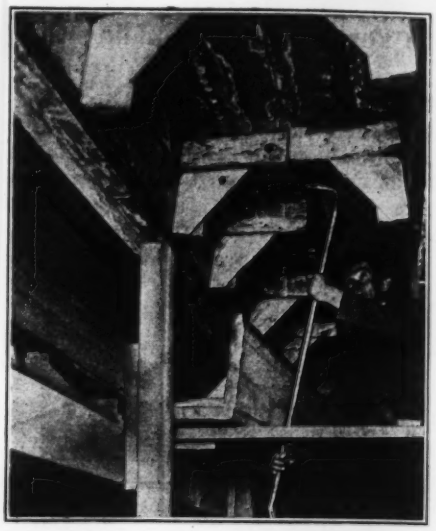


WOOD BOX FLOOR FORMS READY FOR USE
Note small end section where beam joins girder

tractors, of that city. Details of the construction and views in place are given in the illustrations printed herewith.

The floor consists of a 2½-in. slab supported on tapered beams, spaced 3 ft. c. to c. spanning between the girders on the columns. Forms for the beam and slab unit are in about 10-ft. lengths of an inverted "L" shape, making up one of the tapering sides of the beam and the bottom of half of the slab width between beams.

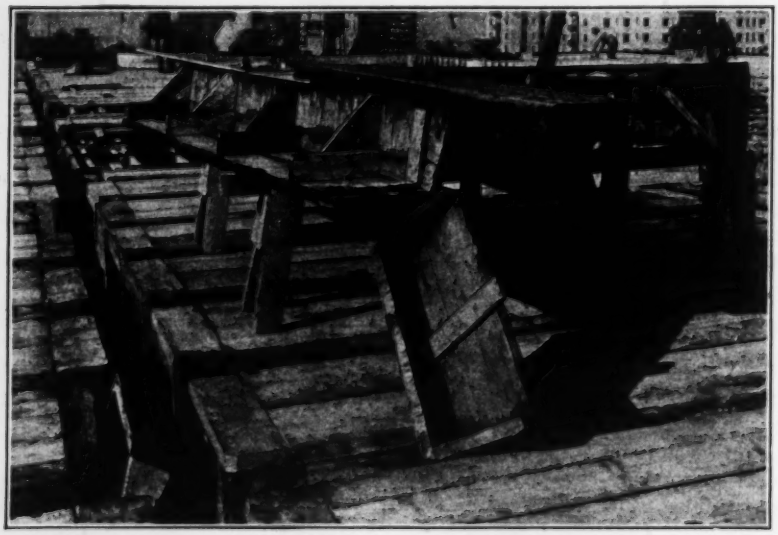
These units are carried on stringpieces and girts at the bottom of the beam section, and at the middle are supported on elevated 1½ x 3-in. stringers which rest on small supports tacked to the stringpieces. A ...-in. opening between adjacent slab forms is covered with a strip of tarred felt over which the concrete is poured.



SPECIAL BARS USED TO REMOVE FLOOR FORM UNITS
Note scaffold to catch forms

The bottom of the beam is carried on a separate strip, which is permitted to remain in place after the forms are removed, to serve as a tacking strip to which are attached the plaster ceiling boards. The ends of the floor-beam forms are beveled, and a separate piece squaring the ends is used to facilitate form removal.

In the stripping, wedges against a small piece on the stringpiece are knocked out, the vertical holding strips are removed, and the forms are taken off with bent bars, as shown in one of the views. Special scaffolding was provided about 2 ft. below the forms on which to drop them in the removal process. The forms were used many times without any considerable intermediate repair being required.



RE-USABLE WOODEN FLOOR BOXES FOR CONCRETE FLOOR

Washing Sand for Concrete

BRITISH practice in preparing fine aggregate for concrete was outlined by P. G. H. Boswell in a paper before the Concrete Institute, as follows: "Some method of 'scrubbing' is the only way to clean ballast effectively from adherent clay and loam. On the other hand, the dust produced in the crushing of aggregate can easily be washed away. If the aggregate is required down to 50-mesh, an upward current of water at ordinary temperatures of about 5 ft. per minute will remove all material smaller than this. If the aggregate is required to be not smaller than 20-mesh, a velocity of about 15 ft. per minute will remove the material not required."

NEWS OF THE WEEK

New York, June 26, 1919

Roumania Wants Americans to Rebuild Its Bridges

Commission Now in This Country to Make Arrangements for Delivery of 25,000 Tons of Bridge Steel

Opportunity is afforded American bridge contractors to enter the European field, in the construction of a number of large bridges destroyed in Roumania during the war. There is now at the Hotel Cumberland, New York City, the Roumanian Bridge Commission, sent here by the Roumanian government to get proposals on this bridge reconstruction. The total amount of steel needed is about 25,000 tons, practically all in railway single-track bridges, although some highway bridges are required.

While the Roumanian finances are in process of reconstruction, it is probable that the firms taking over the bridge work will have to arrange for a time at least to finance the projects, but the stability of Roumania seems assured, and the rapid assumption of its financial responsibilities a matter of a short time.

The principal bridge to be replaced is that over the Borcea branch of the Danube, on the line which connects Bucharest with the sea at the port of Constanta. This point of the Danube is divided into two branches, and there is a large bridge with cantilevers of about 400-ft. span in each branch. One of these branches was destroyed by the Roumanians in their retreat from the Dobrudja. The Germans, it is understood, had intended to replace this bridge, and have in their shops in Germany a new bridge of about 2700 tons, of which 2000 tons is ready to deliver. The Roumanians, however, do not choose to do business with the Germans and utilize this structure.

It is announced that spans from 20 to 65 m. are required, a total of about 1500 m. for double-track and highway and 1700 m. for single-track railway bridges. Delivery should be made as soon as possible to Roumanian ports, the principal one of which is Constanta on the Black Sea.

Army Equipment from France To Be Distributed to States

In response to a request from the Department of Agriculture, the War Department has ordered returned from France, as soon as possible, a large quantity of engineering equipment to be distributed by the Department of Agriculture through the Bureau of Public Roads to the states for use in the construction and maintenance of Federal-aid highways. The equipment will be apportioned on the basis of the allotments in the Federal-aid road act in the same way in which the 20,000 Army motor trucks are now being distributed.

Included in the equipment which has been requested are 1500 caterpillar tractors; 400 road rollers, and a large number of concrete mixers, road graders, elevating graders, rock crushers, industrial locomotives, industrial-railway tracks, dump cars, steam shovels, hoisting engines, electric motors, and quantities of smaller equipment. The Bureau of Public Roads will distribute this equipment, when received, on requests from the state departments.

Employment Bureaus

Engineering Societies' Employment Bureau of the four founder societies, conducted by Engineering Council Employment Service, for members and for other professional men introduced by members. Especial attention for those released from Government service. Address, 29 W. 39th St., New York City.

American Association of Engineers, 29 S. La Salle St., Chicago. Service to members only, but Army or Navy Engineers in uniform who are eligible to certified membership may join without payment of entrance fees or dues while in uniform and for six months after discharge.

Engineers' Service Bureau, 57 Post St., San Francisco. Only applications by mail or wire will be considered.

Professional and Special Section, United States Employment Service, 469 Fifth Ave., New York City.

Reëmployment Committee of New York City for Soldiers, Sailors and Marines, 233 Broadway, New York City.

Extend Alaska Railway Location

The Alaskan Engineering Commission has sent out a party to locate the route of the Alaska Government railway on the 100-mile gap from the Susitna River north through Broad Pass, to connect the present line running north from Seward and Anchorage with that running south from Nenana. The party is in charge of T. W. Secrest. William C. Edes is chairman and chief engineer of the commission. The progress of work on this railway was described in *Engineering News-Record* of Jan. 2, 1919, p. 46.

Commerce Chamber Committee Railroad Report

Conclusions Provide for Early Return of Roads to Private Operation With Guaranteed Returns

Emphasizing adherence to a policy of corporate ownership and operation of railroads, the committee on railroads of the Chamber of Commerce of the United States, appointed to investigate and report on remedial legislation, has submitted 10 separate recommendations providing for the return of the railroads to corporate operation as soon as the necessary legislation can be enacted, the consolidation of a limited number of strong competing systems, exclusive Federal regulation of capital expenditures, and guarantee of return on investment through rate regulation. The recommendations of the committee are now being submitted to all members of the Chamber of Commerce in the form of a letter ballot, merely as a means of obtaining tthe opinion of the commercial organizations of the country regarding a final settlement of the railroad situation.

The recommendations of the committee provide for:

Adherence to the policy of corporate ownership and operation, with comprehensive regulation.

Return of roads to corporate operation as soon as remedial legislation can be enacted.

Adherence to the period of Federal control as now fixed unless and until impossibility of remedial legislation in this period clearly appears.

Permission for consolidation in the public interest, with prior approval by Government authority, in a limited number of strong competing systems.

A requirement that railroad companies engaging in interstate commerce become Federal corporations, with rights of taxation and police regulation reserved for states.

Exclusive Federal regulation of capital expenditures, and security issues of railroads engaged in interstate commerce, with provision for notice and hearing for state authorities.

Federal regulation of intrastate rates affecting interstate commerce.

A statutory rule providing that rates in each traffic section shall yield an adequate return on a fair value of the property as determined by public authority.

Payment into a fund of a share of the excess earned by any railroad system under application of the above statutory rule over an equitable minimum return upon the fair value of the property, this fund to be used as Congress directs for strengthening general railroad credit and increasing general railroad efficiency.

A Federal transportation board to promote development of a national system of rail,

water, and highway transportation and articulation of all transportation facilities.

In explanation of the recommendation for consolidating a limited number of strong competing systems, the committee points out that the regrouping should be about the present large systems and not by territorial subdivisions of the country, maintaining competition in service and permitting financial aid to weak roads from strong systems.

In connection with the provision guaranteeing return on investment through rate adjustment and the turning over to Congress, to strengthen railroad credit, of income in excess of an equitable return on investment, it is stated that the purpose is to prevent individual companies from obtaining excessive profits at the expense of others and that the proposed rule would not deprive the present prosperous roads of an equitable return, but would at the same time tend to strengthen railroad credit as a whole.

Transport Committee Plans Better Highway Transportation

With the idea of producing better transportation conditions and increasing the use of highway haulage throughout the country, the highways transport committee of the Council of National Defense has sent out two bulletins. One of these consists of a letter to all representatives and senators requesting that they have surveys made of their districts with a view to determining where there is a lack of transportation facilities and a need for rural motor express; the other concerns a nation-wide campaign for the adoption of uniform highway traffic regulations and gives notice of the preparation of directions to traffic. This, it is believed, will decrease the large number of accidents that now occur upon the highways.

In writing to the senators and representatives, attention is called to a number of examples where farm and other products have been ruined on account of inadequate transportation facilities. It is felt that conditions similar to the examples given exist, in all probability, throughout the country. The survey is for the purpose of giving the council the necessary information for establishing motor transportation for such localities. The communication sets forth that the railroads and electric roads which need more traffic will be benefited by the traffic developed and also that the cost of the commodities will be decreased by the increase in the supply.

The traffic regulations referred to are those recently compiled by William P. Eno and submitted for criticism to various traffic associations and highway engineers throughout the country. They give minute directions for the proper procedure in driving motor vehicles on the highways, and for pedestrians in crossing the highways. These have been printed in a folder for distribution. It is hoped by this means to reduce the number of accidents both in cities and country districts.

Arguments Against National Highways Answered

Highway Industries Association Replies to Criticisms of the Proposed System by Secretary Houston

Replying to arguments advanced by Secretary of Agriculture Houston, as reported in *Engineering News-Record* of May 29, 1919, p. 1083, against the proposal to form a Federal Highway Commission to build and maintain a national highway system, the Highway Industries Association calls attention to the impossibility of obtaining such a system by present methods. The fact that the proposed law would not interfere in any way with the coöperative plan now existing between the states and the Federal Government, as suggested by Mr. Houston, is also brought out. Extracts from the association's statement follow:

The National highway bill introduced into Congress by Senator Townsend, providing for the creation of a Federal highway commission and the establishment of a national system of highways, is a piece of legislation designed to bring about the construction of a national highway system in a reasonable length of time, to coördinate all the highway activities of the Federal Government, and to publish statistics and data on highway transportation, construction and maintenance for the benefit of all the people.

Arguments made against this bill in a letter from the Secretary of Agriculture to a city chamber of commerce were: "That the roads in each section of the country are of varying degrees of importance in the service rendered or that may be rendered to any particular locality. That the traffic conditions vary greatly in the different sections. That the state highway departments are better able to classify the roads than anyone else. That under the present Bankhead bill the Government is coöperating with state highway departments in the classification of the roads, and that when the classification has been carefully made, and by agreement between the state highway departments of adjoining states, the roads of first importance generally meet at state boundaries." Having the above points in mind, Mr. Houston stated that he could not see the wisdom of "substituting for the present coöperative program a plan which would commit or limit the Federal Government to the construction of two Federally-owned trunk-line highways in each state."

The national highway bill does not in any way interfere with the plan now existing among the states to coöperate with the Federal Government. It only substitutes for the Secretary of Agriculture the Federal Highway Commission, which, under the law, is charged with the duty of carrying out the provisions of the Federal-aid law as now operated, and all other obligations or contracts entered into by the Secretary of Agriculture with the respective states. The national highway bill is entirely a new piece of legislation. Its object is to build trunk-line highways in each state, to the extent of not less than 2% nor more than 5% of the total mileage of the state, and to join them up with the main trunk-lines of other states, so as to make a complete national system connecting the entire country. It creates a system of national highways, independent of the states—highways that will carry interstate traffic and that are necessary for the welfare of the country as a whole.

Under the present Federal-aid law the Federal Government has no power to select the roads in any one state that will be improved. The initiative is with the state highway departments, and in many instances is really with the counties, which have to put up the state's share of the money.

The only limitations prescribed by the Federal-aid law are that the roads shall be "rural post roads." When a road has met this condition, it is the duty of the Secretary of Agriculture to give his approval to its construction. All Federal-aid projects start with the 48 state highway departments, and such projects are considered in 48 different lights, by 48 different men, holding 48 opinions, and it can be seen that a national plan that would evolve from such a procedure would be most chaotic, to say the least. Furthermore, the personnel of these departments and with them the state highway systems are constantly changing. It is also impossible under the Federal-aid law to coördinate the 48 state systems that a plan would be finally evolved that would form a connected system throughout the country in a lifetime.

Many of the states have laid out a system of state highways. Many of the roads as laid out, on which Federal-aid is being expended, should not be and never will be classified as national highways, but they constitute a large portion of the mileage of the plans that have been approved as a general state system, and on which there has already been granted Federal aid.

We have seen the road work of the country expand from the township unit into the county unit; from the county unit into the state-aid unit; from the state-aid unit to the state unit; from the state unit to the Federal-aid unit, and it is but logical and reasonable that the final steps should be taken by establishing a Federal unit.

Many of the highway activities of the states were carried on in coöperation with the agricultural departments of the state or with the agricultural colleges, but it was soon found necessary to provide an independent unit of the state Government to look after this one important development. Likewise, the day has come when the road work of the Federal Government should be separated from the Agricultural Department. The advocates of good roads are only asking in this national highway bill that the roads should be put on an equal footing with the other departments of the Government, so that they can receive proper consideration and study.

Bids for Hetch Hetchy Dam Asked

Bids for the construction of the Hetch Hetchy dam for the San Francisco water-supply will be opened July 30. The dam will be of cyclopean concrete, 212 ft. high above the stream bed, but designed for a possible addition of 100 ft. The thickness will be 320 ft. at the lowest point, 168 ft. at the stream bed and 25 ft. at the 212-ft. height, where the length will be 600 ft. There will be 128,000 cu.yd. of excavation and 360,000 cu.yd. of concrete. The contract provides a bonus of $200 a day for completion in less than the 900-day contract period and a penalty of like amount for noncompletion. The estimated cost of the dam is $4,000,000. M. M. O'Shaughnessy is city engineer.

Public Service Engineers of New York Organize

The engineers of the Public Service Commission, New York City, have formed the Rapid Transit Engineers' Association. It is stated that these engineers have received no increases of pay in the past five years.

To discuss the problem, the foregoing association (whose membership is now about 600) has called a meeting to be held June 26 at the Municipal Building. To this meeting, engineers of other departments of the city Government than the Public Service Commission have also been invited to come.

Imperial Valley Active on All-American Canal

A contract was recently entered into between the United States and the Imperial Irrigation District, and it was ratified by a two-thirds majority of the voters within the district. Under this contract the district undertakes to construct an All-American canal from

Laguna Dam to serve the present irrigated area within the United States in Imperial Valley. It is contemplated that this canal will also serve all of the additional land, to the east, north and west of the present irrigated area, that can be irrigated from the new canal by gravity. A delegation representing the district has been sent to Washington to complete negotiations with the Government preparatory to beginning work.

Labor Advocates Scientific Research

A resolution in favor of a "broad program of scientific and technical research" was adopted by the American Federation of Labor at its Atlantic City convention, concluded this week. The supporting arguments, as well as the resolution itself, follow:

Whereas, scientific research and the technical application of results of research form a fundamental basis upon which the development of our industries, manufacturing, agriculture, mining, and others, must rest; and

Whereas, the productivity of industry is greatly increased by the technical application of the results of scientific research in physics, chemistry, biology and geology, in engineering and agriculture, and in the related sciences; and the health and well-being not only of the workers, but of the whole population as well, are dependent upon advances in medicine and sanitation; so that the value of scietific advancement to the welfare of the nation is many times greater than the cost of the necessary research; and

Whereas, the increased productivity of industry resulting from scientific research is a most potent factor in the ever-increasing struggle of the workers to raise their standards of living, and the importance of this factor must steadily increase, since there is a limit beyond which the average standard of living of the whole population cannot progress by the usual methods of readjustment, which limit can only be raised by research and the utilization of the results of research in industry; and

Whereas, there are numerous important and pressing problems of administration and regulation now faced by Federal, state, and local Governments, the wise solution of which depends upon scientific and technical research; and

Whereas, the war has brought home to all the nations engaged in it the overwhelming importance of science and technology to national welfare, whether in war or in peace, and not only is private initiative attempting to organize far-reaching research in these fields on a national scale, but in several countries Governmental participation and support of such undertakings are already active; therefore be it

Resolved, by the American Federation of Labor in convention assembled, that a broad program of scientific and technical research is of major importance to the national welfare and should be fostered in every way by the Federal Government, and that the activities of the Government itself in such research should be adequately and generously supported in order that the work may be greatly strengthened and extended; and the secretary of the federation is instructed to transmit copies of this resolution to the President of the United States, to the President pro tempore of the Senate, and to the Speaker of the House of Representatives.

American Society of Civil Engineers at Minneapolis

Following the meeting of the American Society of Civil Engineers, at which the development committee report, details of which were given in last week's issue of *Engineering News-Record*, was discussed, members of the society spent four days in visiting engineering works and in various social affairs planned to increase acquaintanceship among the members. At the business meeting, in addition to the development committee discussion, it was announced that the vote taken upon the question of the form in which the list of members should in future be printed resulted in a majority for the plan to consolidate all lists into one. The vote also favored discontinuing the publication of changes of address in the monthly *Proceedings*.

The evening of June 17 was devoted to a reception tendered by the local membership at the Radisson Hotel. Wednesday was entirely given up to an automobile drive around the Twin Cities, with luncheon at the St. Paul Hotel, in St. Paul, and dinner at the St. Paul Town and Country Club, these functions being arranged by the St. Paul Engineers' Society.

Thursday was devoted to an all-day excursion to Lake Minnetonka, which included a two-hour trip on the lake, followed by luncheon at the Lafayette Club. A golf tournament, with prizes donated by the local committee, was held in the afternoon. On Thursday evening Lieut. Col. F. W. Scheidenhelm delivered an illustrated lecture on "The Work of Engineer Troops of the American First Army in France." This was followed by a smoker under the auspices of the Minneapolis Engineers' Club.

On Friday morning the party broke up into small groups for visits to various engineering projects around Minneapolis and St. Paul. At 1.30 p.m. a special train left for Duluth, where the members were received by a large delegation composed of the Duluth Association of Members of the American Society of Civil Engineers and the Duluth Engineers' Club. A steamer was in waiting, and several hours were spent in a cruise about the Duluth-Superior harbor.

At 6.30 a.m. Saturday a special train started from Duluth, via the Duluth, Missabe & Northern Ry., to Hibbing, where the party transferred to flat-cars for a trip down into one of the big open-pit iron mines. Luncheon was served at the Oliver Club, by the courtesy of the Oliver Iron Mining Co., and then, under the auspices of the Engineers' Club of Northern Minnesota, the party went by automobile along the Iron Range 30 miles to Eveleth, thus affording an opportunity to see the development of the Missabe open-pit mines, which produced 60,000,000 tons of ore last year. At Eveleth the special was in waiting to take the party over the Duluth & Iron Range R.R. to the ore-shipping port of Two Harbors, where an inspection was made of the ore docks. The special returned to Duluth at 8.30 p.m., and the party, after a drive around the boulevard on the heights above the city, was entertained at a reception and dance at the Kitchi Gammi Club, the festivities closnig in time to permit the visitors to catch the special leaving at midnight for Minneapolis.

MEMBERS OF THE AMERICAN SOCIETY OF CIVIL ENGINEERS ON FLAT CARS INSPECTING OPEN-PIT IRON MINE AT HIBBING

About three hundred members were in attendance at the meetings and inspection trips in St. Paul and Minneapolis, and probably a hundred more joined the party at Duluth.

Important City Charter Changes in Philadelphia

Notable changes in the charter of the City of Philadelphia have been made in a bill which has passed the Pennsylvania legislature. The old two-chambered council of many members is replaced by a single relatively small council. The councilmen will be paid $5,000 a year. The bureau of health will become a department. There will be a city architect in the mayor's department. To the city-planning commission are given statutory powers.

Street Cleaning and Garbage Changes at Philadelphia

Under the new charter for Philadelphia recently enacted by the legislature, the city will clean its streets and collect and dispose of its garbage, rubbish and ashes, after Dec. 31, 1920,

unless the council by a majority vote, with the approval of the mayor, authorizes the letting of contracts for the work. In the latter event, the present contract restriction of one year is removed. In case a contract for more than four years is made, the city has the option of terminating it at the end of that time or any time subsequently, without damages to the contractor for loss of profits for the unexpired portion of the contract.

Indianapolis Asks Bids on Sewage-Disposal Plant

The board of sanitary commissioners of Indianapolis, Ind., has invited bids for the first of the five sections of the new sewage-disposal plant, and will soon invite bids for the second division. The estimated cost of these are $300,000 and $450,000, respectively, while the total cost of the plant will be about $2,000,000. The first division includes the grit chambers and screens, a 60-in. cast-iron siphon, 1000 ft. long, to pass under the White River, and a 78-in. concrete conduit extending 7700 ft. to the pumping station. The second division will include the buildings for the disposal plant at Sellers farm. For handling the sewage there will be six electrically-driven turbine pumps. Charles H. Hurd is consulting engineer to the board.

Large Dam To Be Built For New York Water-Supply

Contract has been awarded the Hugh Nawn Contracting Co., by the New York City Board of Water Supply, for the construction of Gilboa dam, in Schoharie County, New York, a part of the recent addition to the water-supply of New York City. The dam will divert the Schoharie River from emptying into the Mohawk and divert it to the Ashokan reservoir. It is in two parts, a concrete gravity overfall section 1300 ft. long and 160 ft. total height, and an earth embankment 1000 ft. long. There will be formed a reservoir six miles long with 20,000,000,000-gal. capacity. Quantities are estimated as follows: Excavation, 500,000 cu.yd.; rolled embankment, 500,000 cu.yd.; cement, 480,000 bbl.; masonry, 400,000 cu.yd. The contract price was $6,819,910.

Civil Service Examinations

United States

For United States civil service examinations, listed below, apply to the United States Civil Service Commission, Washington, D. C., or to any local office of the commission, for form 1312.

Assistant designing engineer, Naval Ordnance Plant, South Charleston, W. Va., $9.20 per diem. July 8. File applications before July 8.

Assistant inspector of engineering material (aircraft), $5.92 per diem, July 15. File applications before July 15.

United States.—Chief ship draftsman, U. S. Navy Department, $10 to $12 per diem, draftsman, grade A, $8 to $9.60 per diem; draftsman, grade B, $6 to $7.20 per diem; draftsman, grade C, $5.20 per diem. No date specified. Applications should be filed without delay.

United States.—Chief draftsman, general engineering, architectural, power plant, heating and ventilating, electrical, U. S. Navy Department, $10 to $12 per diem; draftsman, grade B, $6 to $7.20 per diem; draftsman, grade C, $5.20 per diem. No date specified. Applications should be filed without delay.

Valuation engineer, $3600-$4800 per year, and assistant valuation engineer, $2500-$3600 per year; technical staff, income-tax unit, Bureau of Internal Revenue, Treasury Department. No date specified.

Master computer, $2400 to $1800 per year, computer (Grade I) $1800 to $1400 and computer (Grade II) $1400 to $900, Ordnance Department. Applications will be received until further notice.

ENGINEERING SOCIETIES

Calendar

Annual Meetings

NEW ENGLAND WATER WORKS ASSOCIATION; Tremont Temple, Boston; Sept. 30, Oct. 1-3, Albany, N. Y.

The Engineering Alumni of the University of Kansas elected the following officers at the fourth annual meeting, held June 16 at Lawrence: President, J. S. Worley; vice-president, W. E. Baldry; secretary-treasurer, George Hood, Kansas University, Lawrence.

The Southern California Association of Members of the American Society of Civil Engineers was addressed June 11 on "Check Dams" by F. H. Olmsted, and on flood-water acts and legislation by Charles E. Haas, the author of the new California conservancy act.

The Cleveland Chapter of the American Association of Engineers elected the following officers at the recent annual meeting: President, F. D. Richards; vice-president, W. P. Blair; secretary, C. M. Williams, and treasurer, A. M. Clark. The chapter is preparing to conduct an investigation of salaries paid technical engineers in Cleveland with a view to working out a schedule of minimum salaries which the county and city will be asked to put into effect.

The Southwestern Society of Engineers, at the recent annual meeting in El Paso, Tex., resolved to organize a publicity committee; to form local sections; to initiate the policy of greater activity in civic affairs; to establish an employment bureau; to make an organized effort to prevent the employment of incompetent men in engineering work, and to approve licensing. It was also resolved that the society is convinced that compensation nearer the modern level of prices is required to retain the services of the best technical men. The board of directors recommended a plan to charter the society as a district of the American Association of Engineers, provided that all of the members of the society go into the association in a body.

The New York Chapter of the American Association of Engineers held a meeting June 25 at which the following papers were presented: "Railroad Engineering," by R. S. Parsons, chief engineer, Erie R. R.; "Highway Engineering," by W. G. Thompson, state highway engineer of New Jersey, and "The Work of the Engineer at the Front with a Combat Division," illustrated, by Col. F. A. Snyder, 103rd United States Engineers.

The Portland Chapter of the American Association of Engineers has effected a permanent organization, with the following officers: President, W. H. Marsh; vice-presidents, A. H. McKeen, T. W. Saul and O. Laurgaard; secretary, R. W. Barnes and treasurer, C. F. Thomas. Tentative plans have been drawn for amalgamation with the Oregon Society of Engineers. They are under consideration by the national board of the American Association of Engineers.

The Engineers' Club of Minneapolis and the Twin City Chapter of the American Association of Engineers have formed a joint engineering committee to assist in the solution of the engineering problems arising in connection with the settlement of the street-railway franchise. F. K. Bennett is chairman of the committee.

The Engineers' Club of Trenton, N. J. gave a reception June 17 to Trenton men who have returned from overseas duty with the engineers.

PERSONAL NOTES

R. T. BETTS, for the past five years deputy chief engineer, Department of Docks, New York City, has resigned to become chief engineer, Robbins-Ripley Co., Inc., 50 Church St., New York City. Mr. Betts has been in the service of the Department of Docks for the past 22 years. He was previously in the Bureau of the Wallabout Improvement, Department of City Work, of Brooklyn, and in water-supply work for the City of Brooklyn. He was graduated from the School of Mines, Columbia College, in 1890.

CAPT. WALTER S. INGALLS, U. S. A., who recently returned from France and received his discharge from the service, has been appointed adjutant

general of the State of Arizona. For a number of years previous to his war service he was an engineer in the office of the surveyor general of the state. He is a veteran of the Spanish-American War and has been connected for some time with the Arizona National Guard.

CHARLES C. COOK, has resigned as city engineer of Wheeling, W. Va., after 16 years of service.

HARRY W. BOETZKES, formerly in irrigation, highway and contracting work in the Northwest, with headquarters in Seattle, and since 1917 captain with United States Engineers in France and the Balkan States, has returned, demobilized, with the Roumanian Bridge Commission, and in that connection will make his headquarters in New York City.

CAPT. HARRY TUCKER, Engineers, U. S. A., who recently returned from France and received his discharge from the service, has been appointed associate professor of highway engineering, State College of North Carolina, and becomes acting head of the new department of highway engineering, which has just been created as a subdivision of the civil engineering department.

JAMES E. SELLERS, formerly of San Diego, Calif., and Phoenix, Ariz., has returned to the States after serving for 18 months with the 23rd Engineers. Mr. Sellers was one of the organizers of the Society of the 23rd Engineers, now having a membership of nearly 4000. He will return to Phoenix and resume his engineering practice.

MAJ. ERIC KEBBON, Engineers, U. S. A., who recently received his discharge from the service, has become associated with Welles Bosworth in the practice of architecture, with offices at 527 Fifth Ave., New York City.

WILLIAM MCGIBBON, previously of the State Highway Commission of Iowa, has been appointed county engineer with headquarters at Knoxville, Iowa, succeeding W. O. PRICE, who has been appointed district engineer, with headquarters at Chariton, as noted elsewhere.

W. SYDNEY WAGNER and ROBERT R. HOUSTON have been admitted to partnership with William S. Post and J. Otis Post in the firm of GEORGE B. POST & SONS, architects, New York City and Cleveland. The business is to be continued under the present firm name.

LIEUT. JOHN A. FULKMAN, Sanitary Corps, U. S. A., has received his discharge from the service and has resumed his former work as assistant engineer, MORRIS KNOWLES, INC., engineers, Pittsburgh.

LLEWELLYN N. EDWARDS, supervising engineer of bridges, Department of Works, Toronto, Ont., has resigned to become senior highway bridge engineer, United States Bureau of Public Roads, Washington, D. C. He was graduated from the University of Maine in 1898 and engaged in bridge-engineering work. In 1905 he became designer and estimator, office of the bridge engineer, Boston & Maine R.R., and later engaged in similar work for the Chicago & Northwestern Ry. In 1907 he was appointed structural engineer, Grand Trunk Ry. In 1913 he joined the engineering staff of the City of Toronto.

H. A. SEWELL, formerly county engineer, Pend O'Reille County, Washington, has been appointed engineer, Panhandle Highway District of Idaho, with headquarters at Spirit Lake.

JULIUS K. MUNROE, previously of the engineering department, Morgantown & Kingwood Ry., has been appointed state road commissioner of West Virginia, with headquarters at Charleston, succeeding T. S. SCANLON, resigned.

H. G. CLARK, chief engineer, Chicago, Rock Island & Pacific R.R. previous to the recent return of C. A. Morse, has been appointed assistant to the Federal manager, succeeding H. M. SLOANE, resigned to become assistant to the president, Chicago, Milwaukee & St. Paul R.R., as noted elsewhere.

LIEUT. WILLIAM L. STANTON, Engineers, U. S. A., who recently returned from France, has been discharged from the service and is now in the office of the city engineer, Flint, Mich.

I. J. EIDMAN, assistant bridge engineer, Kansas State Highway Commission, has been appointed bridge engineer, South Western Engineering Co., Hutchinson, Kans.

H. M. SLOANE, assistant to the Federal manager, Chicago, Rock Island & Pacific R.R., has resigned to become assistant to the president, Chicago, Milwaukee & St. Paul Railroad.

HARRY S. MARSHALL, has resigned as chief engineer, A. J. Yawger & Co., general contractors, Indianapolis, to become chief engineer in charge of construction, F. K. Vaughn Building Co., Hamilton, Ohio.

LIEUT. HENRY J. HORN, Sanitary Corps, U. S. A., recently returned from France, has received his discharge from the service and has resumed his former work with GANNETT, SEELYE & FLEMING, engineers, Harrisburg, Penn.

R. E. BURGER has resigned as president and general manager of the Richland Public Service Co., of Ohio, to become chief engineer of Henry L. Doherty & Co., public utility operators, New York City.

MAJ. THERON M. RIPLEY, U. S. A., has received his discharge from the service and will return to his duties as division engineer, Division No. 3, State Highway Department of New York, with headquarters at Watertown.

H. A. MARSHALL, acting road engineer, Kansas State Highway Commission, has been appointed chief engineer, South Western Engineering Co., Hutchinson, Kans.

LIEUT. H. E. MILLER, Construction Division, U. S. A., who was recently discharged from the service, has been appointed director of the bureau of engineering and inspection, North Carolina State Board of Health, with headquarters in Raleigh.

HARRY CONRAD, of the firm of COULTER & CONRAD, engineers, Wheeling, W. Va., has been appointed city engineer of Wheeling, succeeding CHARLES C. COOK, resigned.

FRED OLDER, Adrian, Mich., has been appointed city engineer of Ypsilanti, Mich., succeeding W. R. CALDWELL, resigned to become chief engineer of the Palma Construction Co., Ypsilanti, as noted elsewhere.

GEARY KIMBALL, CHARLES SEMPER and C. W. CROSS have been assigned as highway engineers to the Ogden, Utah, branch of District No. 2, United States Bureau of Public Roads.

W. R. CALDWELL has resigned as city engineer of Ypsilanti, Mich., to become chief engineer of the Palma Construction Co., highway contractors of Ypsilanti.

LIEUT. CHARLES BOYCE, U. S. A., has received his discharge from the service and will report to the American Red Cross at Washington, D. C., to become sanitary engineer.

W. O. PRICE, county engineer, Knoxville, Iowa, has been appointed district engineer, with headquarters at Chariton.

J. F. WITT has resigned as county engineer of Dallas County, Texas, in which position he has served since 1907.

FRED W. SIMONS, city engineer of Rahway, N. J., has been appointed city manager of Elizabeth, N. C.

D. E. GILMER, of Hutchinson, Kans., has been appointed superintendent of construction, Federal-aid roads, Reno County.

FRED HOFFMAN, contractor and engineer of Long Beach, Calif., has been appointed city engineer.

A. R. TOWSE has been elected county engineer of Pensacola, Fla.

OBITUARY

ERWIN F. PAYNE, head of the E. F. Payne Paving & Contracting Co., Cleveland, died recently in that city. He had been at the head of the company for the past 40 years and was actively engaged in the business until his retirement two years ago.

FRANK C. LAMARCHE, general superintendent, South Chicago Shipbuilding Co., died recently in Chicago. He was previously general superintendent of the American Shipbuilding Co., of Cleveland.

West Coast Lumbermen To Hold Annual Meeting

The West Coast Lumbermen's Association announces that it will hold its annual midsummer meeting at Paradise Inn, Mount Rainier National Park, July 30-31. It is expected that lumbermen from both Oregon and Washington, with their families, will attend the convention in large numbers.

A report will be made by Axel Oxholm, who has just returned from the Scandinavian countries, where he studied lumber trade conditions for the United States Department of Commerce. Other speakers will be C. E. Paul, consulting engineer for the National Lumber Manufacturers' Association; Chester J. Hogue, in charge of the West Coast Association's New York office, and L. C. Boyle, attorney for the national organization.

Asphalt Association Announces Increase in Staff

Several additions to its organization have been announced by the Asphalt Association, recently formed, as reported in *Engineering News-Record* of June 19, 1919, p. 1237. The research and testing department of the association is headed by Prevost Hubbard, formerly chief of the research and testing division of the Bureau of Public Roads.

Several field engineers have also been appointed; Fred W. Sarr, formerly second deputy highway commissioner of New York; A. T. Rhodes, who was for several years street commissioner of Worcester, Mass., and, more recently, secretary of the Granite Block Manufacturers' Association, will have charge of the New England territory and other Eastern points; and J. B. Hittell, formerly city engineer of Chicago, who will have charge of the association's work in the Middle Western States. No representative for the district to be controlled from the Atlanta, Ga., office has been named.

Canadian Industrial Congress To Be Held at Calgary

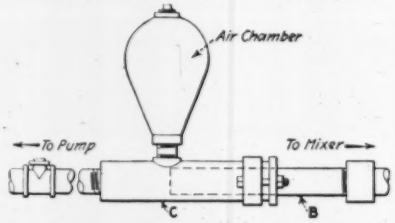
Western Canada is to have an industrial congress which will meet at Calgary, Alta., Aug. 13-14, and will then take a trip through the territory, including other Western Canadian cities. Among the places to be visited will be Medicine Hat, Alberta and Edmonton. The congress will be educational to a large extent, and along industrial lines.

Some of the subjects for discussion are: "Western Markets," "Western Industry," "Pacific Trade and Transportation Routes," "Oriental Commerce," "Future Alignment of Manufacturing, Considered with Reference to the East and West," and the question of building up the Pacific regions and adjacent inland territories. Congress headquarters have been opened at the Palliser Hotel, Calgary, Canada, under the manager, John M. McGreevy. Further information may be obtained there.

Expansion-Joint Air Chamber for Roadbuilders' Pipe Lines

A combined expansion joint and air chamber to prevent water hammer, for pipe lines laid above ground in roadbuilding and other work, is shown in the accompanying illustration. It is claimed that this joint will overcome all the difficulties due to contraction and expansion of pipes which throws them out of line, while the air chamber prevents trouble with water hammer which often breaks pipe and mixer hose when the water is shut off suddenly.

One of these expansion joints is recommended for every 800 to 1000 ft. of



PIPE LINE EXPANSION JOINT AND AIR CHAMBER

pipe. While the combination joint and air chamber can be supplied, it is not necessary to use the air chamber on every joint. Its use upon about every third joint is said to be sufficient.

The expansion joint, which allows for 12 in. of expansion or contraction, is formed by having a brass pipe B, which telescopes into the casing C through a gland or stuffing box. The pipe line is connected to each end of the combination, which thus becomes a part of the line.

The combination described is manufactured by the C. H. and E. Mfg. Co., of 384 Clinton St., Milwaukee, Wis.

Business Notes

THE OSHKOSH MFG. CO., manufacturer of contractors' machinery and equipment, of Oshkosh, Wis., has reported the appointment of Ross Hunter as Eastern sales manager. Mr. Hunter has had long experience in the machinery selling field, his territory covering the entire country. His offices will be at 154 W. 38th St., New York City, where a complete line of Oshkosh contracting machinery will be kept in stock.

THE MACON CONCRETE ROLLER CO., of Macon, Ga., has been formed to manufacture concrete paving rollers by a process patented by W. L. Ashmore and W. T. Morgan, Jr.

THE C. J. CARTER LUMBER CO., of Kansas City, Mo., THE DONIPHAN LUMBER CO., of Kensett, Ark., and THE MARSH AND TRUMAN LUMBER CO., of Chicago, which are all manufacturing and selling interests of Bloxonend flooring, give notice that they have been merged into a single corporation, to be known as the CARTER BLOXONEND FLOORING CO., with home office in Kansas City. The sales office will be located at 1601 McCormick Bldg., Chicago, Ill. The individual lumber business of each of these firms will be continued under the old names as heretofore. C. J. Carter, the president, will have charge of the Kansas City office, while M. G. Truman, the vice-president, will be in charge of the Chicago office.

THE MCGRAW-HILL CO., INC., of 10th Ave. at 36th St., New York City, reports the removal of the Western office of *Chemical and Metallurgical Engineering* and *Engineering and Mining Journal* from the Newhouse Bldg., Salt Lake City, Utah, to the Rialto Bldg., San Francisco, Calif.

THE AUSTIN CO., of Cleveland, Ohio, announces that O. D. Conover, formerly vice-president and chief engineer of the C. W. Price Engineering Co., of New York and Chicago, and production manager of the Ludlum Electric Furnace Co., has resigned the latter position to become associated as production and sales engineer on foundries and steel plants for the Austin Co. Mr. Conover has had experience as engineer in charge of the design and construction of a large number of steel plants, foundaries, electric furnaces, and other equipment, both in this country and abroad.

THE SULLIVAN MACHINERY CO. has established a branch office at Room 810 Park Bldg., Cleveland, Ohio, under the management of Ralph T. Stone, formerly sales engineer in the New York office.

Trade Publications

The following companies have issued trade publications:

THE HOLT MANUFACTURING CO., of Peoria, Ill.; bulletin, 9 x 12 in., 16 pages, illustrated; describes the various standard sizes of Caterpillar tractors.

THE TRAILMOBILE CO., of 571 East Fifth St., Cincinnati, Ohio; catalog 7 x 9 in., 31 pages, illustrated, and three folders 8½ x 11 in., illustrated; describe various forms of trailers manufactured by the company.

THE AMERICAN MANGANESE BRONZE CO., of Holmesburg, Philadelphia, Penn.; catalog, illustrated; contains descriptive matter and illustrations of hydraulic castings, gear wheels, propellers, ingots, valves, bronze forgings, etc. The title of the catalog is "High-Grade Bronzes for Engineering Purposes."

THE TIDEWATER OIL CO., of 11 Broadway, New York City; catalog, 6 x 9 in., 46 pages, illustrated; describes the uses, economy and efficiency of fuel oil and the apparatus necessary for its use.